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EVOLUTION.

SOME OF THE OBJECTIONS TO THE EVOLUTION THEORY.

BY THEO. S. CASE, KANSAS CITY, MO.

For some time before I was appointed to read a paper at this meeting of the Academy I had been determining to my own mind that I ought to look up the facts in opposition to the theories of Darwin, Haeckel and Huxley, for fear of being overwhelmed and forced along with the current by the mere ponderosity of the mass of argument, inference and induction poured upon me from every side in the scientific journals with which I exchange my little Monthly, and which of late have formed the principal part of my reading; and your action in so appointing me has merely hastened my action in the matter. My natural inclination from early teaching and training is to discredit the whole theory of Evolution and Natural Selection and to pin my faith to the doctrine of a "supreme conscious and creative power" which "was from the beginning and ever shall be," and to whose wisdom and omnipotence are due the earth and all things within it, but I believe that I am sufficiently free from prejudice to consider the subject fairly and candidly, and also sufficiently interested in science to appreciate and admire the honest and faithful labors of all true scientists. With this bias and

this spirit of fairness equally governing me, I have made my investigations among all classes of authorities within my reach, and herewith give you the results, not attempting to disprove the existence of facts, but merely indicating some objections which to me seem, with present actual knowledge, almost insuperable.

The Evolution theory is no new thing, being readily traceable all along the history of science, from the times of Aristotle to the days of philosophic speculation in the 17th century; through the groping and uncertain experiments and researches of the alchemists to the brilliant and wonderful discoveries of modern scientists in the broad fields of physics, chemistry and biology.

Among the comparatively recent explorers and writers, Lamarck may be regarded as the father of the Evolution Theory, having, as long ago as 1801, in his work on the Vertebrate animals suggested the idea, among many other similar ones, that "Nature, in the long ages during which the world has existed, may have produced the different kinds of plants and animals by gradually enlarging one part and diminishing another to suit the wants of each," and later, in 1809, having written a work called "Zoologic Philosophy," to prove that the way in which the Creator has formed different plants and animals, has been by altering them gradually from simple to complex forms. Another of Lamarck's theories was that new organs could be produced in animals by the simple exertion of the will, called into action by the creation of new wants, and that the organs thus acquired could be transmitted by generation, which was regarded by the naturalists of that day as so unreasonable and preposterous that no attention was paid to it; though, indeed, apparently not only equalled but far surpassed by the evolutionists of the present time.

With these ideas for a starting point or foundation, the grand biological theories of Darwin and others gradually grew, or were evolved, until they have reached such dimensions as absolutely to undertake, not only to account for all the progressive steps of animal birth, life and growth without acknowledging the necessity of Divine influence or action in any of the steps, but even, as Tyndall has recently done, to refuse "to invoke the supernatural in accounting for the phenomena of human life," and "to seek in the interaction of social forces, the genesis and development of man's moral nature."

Supporting their theories by the fact that as the varied forms of animals and plants in different portions of the world became known, it became more and more difficult to separate the different species and decide which were, and which were not, descendants of one parent; by the additional fact that all the animals of each class were formed upon the same plan; and by the still further discovery that the embryos of all animals are so precisely alike, at first, that those of man and the higher quadrupeds cannot be distinguished from those of the lower animals, such as fishes and reptiles, they began to build these theories up by assuming certain points as true without sufficient proof. Thus, they began to read geological history like a printed book, to

assume that succession was development, that because reptiles followed fishes in geological order, and birds reptiles, and quadrupeds birds, and monkeys quadrupeds, and man monkeys, necessarily reptiles were more highly developed than fishes and descended from them, and so with the other animals as they successively appeared on the earth, culminating in *man*, who presents in his feeble frame and defenceless construction all of the excellences of his predecessors in an intensified and perfected condition, with an entire avoidance of their imperfections.

Of course, in following out a theory of this kind, many of the essential facts were wanting, many important links missing, and it became necessary to invent other theories, draw new inferences from newly discovered facts, or supply from imagination those missing links. All this has been done ingeniously, and in many cases, most plausibly. For instance: to account for the comparative scarcity of close links between fossil animals, it is urged that nearly all of the rocks of the earth's crust are made up of others which have been destroyed, and, of course, the intermediate links of progression with them. Just at present efforts are being made to account for the absence of certain necessary geological stratifications or formations, with their needed fossil links in the chain of succession, by putting forth the theory of Catastrophes in the earth's history, as they are called by Prof. Lyell and later by Mr. Clarence King; and Critical Periods, as they are called by Prof. LeConte of California; which means in brief that, as the growth of the earth progressed, certain accidents happened, by which certain strata were either omitted, or to some extent commingled or combined with each other, or checked altogether in their formation; thus accounting for missing links which are necessary for one theory, by advancing other theories perhaps equally insupportable in point of fact, or at least upon which even the theorists themselves are not agreed.

Even with all these theories and their supporting theories, questions based upon them continually arose, which seemed unanswerable, and required the evolution of a new theory to explain. For instance, those who admitted the doctrine of succession wanted to know why these forms of animals and plants should succeed one another and gradually pass into the forms of the living animals and plants of our day? And other questioners wanted to know, on the other hand, how the gradual alteration of plants and animals came about?—*i. e.*, why they did not follow the types of their ancestors?

To meet these questions the Darwinian theory of Natural Selection was put forth, and was most eagerly grasped and universally welcomed and has been used by all of his adherents, from that day to this. Natural Selection may be briefly defined to be "the choosing out by nature, or natural causes, of those plants and animals which are best fitted to live and multiply," or, again, it may be said that the theory of natural selection is, "that nature only allows those animals to live which (by means of superior strength, or swiftness, or some other marked peculiarity) in some way escape the dan-

gers which overtake their neighbors, and thus in time the race becomes altered to suit the life it has to lead." Of course, this theory logically requires that every change produced by it shall be for the benefit of the possessor; that is, for his own immediate and sole benefit, and not in any respect for the benefit of his descendants. This should be borne constantly in mind in considering the subject of Evolution, otherwise we may be led astray, and overlook the absence of many important links in the chain of progression.

This theory is held to explain and account for all of the difficulties in natural history, whether found in the emergence of animal life from the dim Eozoic ages into the secondary formations, or in stepping from the comparatively recent Tertiary into the Quaternary, and thence into the Present.

By this theory, eked out by that of Evolution and supplemented by those of Catastrophes in geology and Critical Periods in the earth's history, it is believed by their adherents that all the steps in the development of protoplasms, through the intermediate grades of insects, mollusks, reptiles and quadrupeds, and finally terminating in *man*, can be fully shown, and any missing links fully and satisfactorily accounted for.

That the evolutionists themselves do not agree as to the value of the Natural Selection theory will appear further on.

Taking up first the doctrine of Evolution or successive, dependent development, I will point out such objections and obstacles as I have found in reading upon this subject recently, together with the few additional ones which have occurred to my own mind after giving due credit to the indefatigable researches and plausible arguments of such careful and conscientious workers and writers as Darwin, Huxley and Marsh.

Going back to the geological ages, and beginning with the Eozoic, we find the earliest traces of organic life in the St. Lawrence limestones, and the possessor of it in the shape of a foraminiferous creature composed of jelly and protected by a strong covering or skeleton of carbonate of lime and growing to an immense size. This animal was appropriately named Eozoon, or the "Dawn animal," in honor of its having probably been present at the dawning of life upon this globe. Now, what did this animal develop into? Was any other and higher form evolved from his almost homogeneous structure? Evidently not, for even at the present day explorers of the ocean depths find beds of foraminiferous, calcareous matter, identical in character and doubtless identical in origin with those of the remotest Laurentian periods; and not only this, but they find the Foraminifera of the present day swarming in astonishing numbers and as actively engaged in manufacturing carbonate of lime as was the Eozoon of those days. We find them living under similar conditions of absence of light and vital air, and of enormous pressure, and finally we find them being fossilized in the same way, and except in dimensions, almost unchanged, undeveloped, in any particular from the protoplasmic mass of the Eozoic ages.

In the next succeeding period, known as the Primordial or Cambrian,

fossils are very scarce and especially in the western hemisphere, where the Eozoon lived and flourished and where, naturally and in accordance with the Evolution theory, we should have expected to find evidences of an advanced stage of animal life in its developing successors. In Europe, however, some fossils have been found in this series, many of which are similar to the Eozoon, and others are the first representatives of the great class of Mollusks, called Lingulæ. Now, singular as it may seem, in spite of Evolution and Natural Selection, these little shell-fish, these Lingulæ, have continued to exist and thrive almost from "the beginning" until now, maintaining their original forms and peculiar characteristics throughout all this incalculable time.

Among the fossils of the Primordial age are also found quite abundantly the Trilobites, which continue to abound in every formation, from the Cambrian to the Carboniferous, and whose descendants, if they had any, which has been questioned, but which the recent investigations of Mr. Walcott among the Trenton limestones render quite certain, may be found in the existing horse-shoe or king crabs, whose habits of life, manner of locomotion and organic structure are almost precisely similar; proving that Evolution has done nothing towards developing the Trilobites into higher organisms.

Though animal life was not very abundant in the Palæozoic ages, it is pretty well established that three of the great subdivisions of animals, viz: the Radiata, the Mollusca and the Annulosa were represented even in those days, while Dr. Bigsby in his *Thesaurus Siluricus* enumerates more than 900 species existing in the Primordial alone, many of which were as perfect in form and structure as any of their descendants, many of which were supplied with structures totally diverse from each other and yet admirably subserving similar ends, and many of which possessed organs, like the multilocular eyes of the Trilobites, as perfect and complex as those possessed by similar animals of the present day.

Coming to the Silurian ages, we pass hurriedly over the huge crustaceans, cuttle-fishes and star-fishes, which seem to have attained their maximum of size and perfection in that age and to have passed almost entirely away, though their sadly deteriorated descendants still exist in our modern seas and oceans, and take up the grand, striking feature of its animal life, the Vertebrate Fishes, which suddenly made their appearance, springing into existence, Minerva like, full armed and equipped, and with structures allied to existing sharks, which occupy the summit of fish organization. This unheralded appearance of vertebrates in the Silurian waters, without previous intimation through any approximating forms of animal life, and of vertebrates whose descendants, almost unchanged in form, structure or habits of life, now swim in our modern seas, is one of the stumbling blocks of the evolutionists. To meet it, the theories of catastrophes and critical periods, with their apparently irreconcileable stages of almost endless, advanceless duration, and then of conveniently "rapid evolution," their "lost intervals" at times and their "fewer and longer steps" at others, have been invented

or invoked. Even the Darwinian theory of the "survival of the fittest" cannot aid them here, for, at the time of the appearance of these fishes, and throughout the Silurian age, the waters were filled with giant crustaceans, Nautili and Polyps, so numerous that they almost covered the bottom of the sea, and, of course, possessed of ravenous appetites, and yet they permitted these small vertebrata to appear, grow, multiply, and finally prey upon them and become the monarchs of the deep.

Coming now to the Devonian age, and hastening swiftly over it, we find the Trilobites approaching their end, while the vertebrate fishes, both Ganoids and Placoids, rise to the zenith of their power and development with no recognizable ancestors, (except those which appeared so unaccountably in the preceding Silurian age), but with descendants innumerable and in a direct line down to the present day.

Coming next to the Carboniferous age, we find that it is, so far as living beings are concerned, the most complete of the Palæozoic periods, or, as it has been beatifully and graphically described, "the summation and completion of them all, and the embodiment of their highest excellence." The few insects that appeared in the Devonian age have largely increased in numbers, though but three species are represented: And singularly enough these three orders are yet represented on the earth in the shape of weevils, mayflies and cockroaches, all of which, though vigorous enough for all of our uses, are mere pigmies in comparison with those of the Carboniferous age. They also possessed, even in this the dawn of their existence, the complex and compound-lensed eyes which render their descendants the wonder and admiration of the most scientific men of modern times.

In this age we meet, for the first time, mollusks, in the familiar shape of common snails, *on land.* Hitherto all animal life seemed to have been confined to the oceans and seas. Now, however, they begin to appear on land, and again we must exclaim, how remarkable! for these snails present almost identically the same form and appearance as those we find to-day in the marshes and low grounds along the margins of our Missouri and Kansas rivers.

Here we also find, suddenly introduced into the geological history, without any evidence of ancestors, either near or remote, those immense reptiles or semi-reptiles which are so closely imitated in form and habits by the alligators and crocodiles of the torrid zone.

The fishes of the Carboniferous remain confined to the two orders of the Ganoids and Placoids.

Upon reaching the Permian age, which has been called the twilight of the Palæozoic day, we find it characterized by the appearance of *true* reptiles, as distinguished from those of the preceding age, which, by some naturalists, are placed among the lower grade Batrachians. Few of the previous orders, however, survived the violent alternations of upheaval and depression in the Permian age, with the rapidly changing chemical conditions necessary to the building up of its varied lithological formations, and its

probable periods of intense heat and cold. Certain it is, however, that we have pointed out some feeble and apparently defenceless animals in the Palæozoic ages which possessed similar complex structures and organisms to those of the later days of the earth's history, and that, whether they survived the catastrophes of the Permian period in some unexplored geological region of its crust, as Professor Cope has suggested in accounting for the sudden appearance of new forms of animal life in the Tertiary, or whether they were completely extinguished before its close, there is no satisfactory fossil evidence that they were evolved one from another. On the contrary, the rocks of that period show the same marked differences in orders and species that are seen to exist between similar animals of the present day. The Foraminifera of those remote ages are found in the ooze of the ocean to-day; the cuttle fishes, nautili, king crabs and vertebrate fishes are met with in our seas almost in the identical forms in which the Palæozoic rocks present them to us, and the powers and influences of Evolution and Natural Selection seem to have modified them so slightly as to render it doubtful whether, in a single instance, one of these orders presents a higher development than it did at the close of the Permian age, thousands and thousands of years ago.

The next grand division made by geologists is known as the Mesozoic or middle age of the earth's history. Its earliest period is called the Triassic, which, though differing but slightly in general features from the Permian, in which the animal forms of the Palæozoic were seen to disappear, is characterized by such a remarkable change and activity in the domain of life that, as has been fitly said by an eminent explorer and writer, "the geologist, whose mind is filled with the forms of the Palæozoic period, feels himself a sort of Rip Van Winkle, who has slept a hundred years, and awaked in a new world." Having buried the animals of the past in the depths of the Palæozoic rocks, it seems wonderful, as we ascend to the succeeding Triassic strata, to come suddenly upon the comparatively well-preserved remains of gigantic Saurians, some of which possessed a muscular development, a complicated tooth structure and a general organization of a far higher type than those of any living reptile; birds of greater size, of a brain development probably superior to, and blood circulation similar to, those of the present day; and land lizards of huge size, possessing many of the attributes of the higher vertebrata and some of those of the mammalia.

If these animals were evolved or developed from previous orders or species, where are the connecting links which prove their descent from anything that existed in the Palæozoic? None have been found. Huxley in England and Marsh in America themselves admit that "the Trias offers at present the first unquestioned evidence of true reptiles," and can only avoid the dilemma in which they are placed, by seeing in the fragments of fossil anatomy which they are studying, *hints* of relationship which are to them "sure *prophecies* of future discoveries." But prophecies are not facts. When these discoveries are actually made, as they are certainly liable to be,

no one will be more ready to welcome them than the adherents of the doctrine of creation, who will see in them still stronger evidences of Divine power and wisdom.

Looking along the line of geological history still further, we find, in the same Triassic formation, the first Mammal making its appearance; a pigmy among giants, it is true, but at the same time a genuine, undoubted mammal, worth hundreds of those "prophecies of future discoveries" just alluded to. This little animal belonged to the marsupials, now as then, the lowest form of mammalian life, but, as I think, a striking illustration of the failure of the Natural Selection theory of Darwin; for while even Professor Marsh has not been able to trace them into any higher and better developed later forms, it has, despite its being the weakest and most incapable of the animals of those days, whether we consider its muscles or its brain, outlived all the powerful monsters of the Mesozoic, and, notwithstanding the oft asserted infallibility of the doctrine of the "survival of the fittest," presents the obstacle to the development theory that, low as it started in the origin of its life, its successors and descendants still live, confined to two species in America and Australia, and still remain examples of the lowest order of mammals on the earth, but little, if any, superior to the feeble Microlestes which stole into the Triassic forests among the giants of the Mesozoic times.

Of the vast numbers of enormous Saurians found in the waters of the Mesozoic age, none outlived that period; but many of the turtles and crocodiles of that day have been continued and now exist in almost the same forms as their pre-historic progenitors, not only of the comparatively recent Cretaceous periods, but even as far back as the Trias.

An examination of this whole Mesozoic period shows conclusively that before the end of this age again all the prominent forms of life peculiar to it had reached their maximum and, at its close, many of them had become extinct, while numbers of the weaker forms before alluded to, such as certain Foraminifera, mollusks and crustaceans of the Primordial ages, were continued through it, and still continue.

In the next geological age, known as the Tertiary or Neozoic, animal life seems to have again commenced with Foraminifera and mollusks, as the remains of such fill the earlier rocks of the period, though the fossil remains of fishes, reptiles, birds and mammals are also found in its lower deposits.

The peculiarly characteristic feature of the Tertiary is the rise and progress of its mammals. We find them on land and in the water, and we find among them apparent types of the animals now existing, though, as Lyell indicates and Dawson remarks, "they are not the survivors of the Fauna and Flora of the Wealden, but a new creation."

Without going into details, we find again that the animals characteristic of and belonging to the Tertiary age, such as the huge megatherium, the mastodon, machairodus and palæotherium, culminated and disappeared before

its close, leaving no descendants, while many of the smaller and apparently less capable animals of the same period survived and passed on into the succeeding age.

Passing over the Glacial period, which dispersed and destroyed most of the animals of the Pliocene age, we hasten to consider those which appeared upon the earth in the Post Glacial period and which now exist upon it with man. These were not known in the Pliocene, and some of them, which we designate domestic animals, seem to be man's natural companions, and essential to his existence upon the earth, even in the present condition of mild temperature and freedom from the horrible monsters of past ages.

Again we find facts, which, in view of the claims of the advocates of Natural Selection, are surprising, and apparently tend to antagonize that theory. We find the remains of many animals which, in the days of primitive man, abounded and flourished, of which there are now no survivors known; and these were not puny and insignificant animals either, but numbered among them the woolly elephant, the woolly rhinoceros, the Hippopotamus major, the Irish elk and the cave bear, all of which were highly organized animals, quite as capable of sustaining themselves in the struggle for the "survival of the fittest" as the sheep and the ox, which have been, since the advent of man, his valued coadjutors and allies.

Having now arrived at the point in the world's history when Man comes upon the scene, we propose to spend a little time in indicating the main weaknesses of the Evolution theory as regards his origin. To use the words of another, "Let us now turn to the picture presented by the theory of the struggle for existence and derivation from the lower animals. It introduces us first to an ape, akin, perhaps, to the modern orang or gorilla, but unknown to us yet by any actual remains. This creature, after living for an indefinite time in the rich forests of the Miocene and earlier Pliocene periods, was at length subjected to the gradually increasing rigors of the Glacial age. Its vegetable food and its leafy shelter failed, and it learned to nestle among such litter as it could collect in dens and caves, and to seize and devour such weaker animals as it could overtake and master. At the same time its lower extremities, no longer used for climbing trees, but for walking on the ground, gained in strength and size; its arms diminished and, its development to maturity being delayed by the intensity of the struggle for existence, its brain enlarged; it became more cunning and sagacious, and even learned to use weapons of wood and stone to destroy its victims; so it grew into a fierce and terrible creature, "neither beast nor human," combining the habits of a bear and the agility of a monkey with some glimmerings of the cunning and resources of a savage.

When the Glacial period passed away our nameless Simian man, or manlike ape, might naturally be supposed to revert to its original condition, and to establish itself as of old in the new forests of the modern period. For some unknown reason, however, perhaps because it had gone too far in the path of improvement to be able to turn back, the reversion did not take

place. On the contrary, the ameliorated circumstances and wider range of the new continents enabled it still further to improve; ease and abundance perfected what struggle and privation had begun; it added to the rude arts of the Glacial period; it parted with its shaggy hair, now unnecessary; its features became softer, and it returned to vegetable food. Language sprang up from the attempt to articulate natural sounds; fire making was invented and new arts arose. At length the spiritual nature, potentially present in the creature, was awakened by some access of fear or some grand and terrible physical phenomenon; the idea of a higher intelligence was struck out, and the descendant of the apes became a superstitious and idolatrous savage."

It is unnecessary to follow the quotation any further to show how he came at last to obtain possession of religious ideas, since the stern and inexorable logic of Spencer leads irresistibly to the same conclusion as the recent declarations of Tyndall, namely: the exclusion of a knowledge of a Creator and the possibility of his works; and hence the poor savage would waste his time in elaborating any system of religion or religious faith.

In opposition to this theory of the origin of man, the following points are urged:

First.—There is nothing in the science of natural history which tends to sustain the idea of the simpler forms of life continuing to progress and change into the more complex forms. In all such physical changes the operations of Nature are in a circle; the seed changes into a plant, a shrub, a tree; the tree gives off seed and dies. So in animal life; like begets like, and no amount of hybridizing can change the essential characters of the parent stock into a new order or species. In this view such naturalists as Professor Kölliker and M. Flourens concur, and Pæschel, author of the "Races of Man," clearly demonstrates that among the sharply defined animal forms any abandonment of original types is followed by the complete extinction of the family. We see in every day life that plants and animals changed from their ordinary forms by cultivation and hybridizing, will return to their original forms when neglected and allowed to run wild.

Second.—The theory of Creation must be admitted by even those evolutionists who, for the origin of life on the earth, go back of protoplasm, Moneres and Bathybius to the meteoric dust of Sir William Thompson. The process of life must commence somewhere, and the whole theory must rest at last upon creative force, for it is just as difficult to account for the origin of the most infinitesimal protoplastic germ or atom of meteoric dust as for any one of the complicated organisms of higher life.

Third.—Animal forms running back to the Foraminifera of the Primordial ages, the Nautili and cuttle fishes of the Silurian, the Placoid fishes of the Permian, and the turtles and crocodiles of the Cretaceous, but more particularly, the animals known to be identical in time of origin with man, not less than 6,000 years ago, have come down to us without intermingling

of races or changes in form or structure; and the longer these periods of separate parallelism have existed, the worse for the evolutionists.

Fourth.—The assumed connection between the Anthropoid apes and man has never been proven by the discovery of any intermediate link either in the near or remote past by the keenest scented evolutionist or student of Palæontology. Agassiz, Mivart and Verchow agree that no links do now or ever did exist between man and apes, while Agassiz sustains Wallace in the opinion that a special creative act of the Deity was required for the development of man. It might also be urged here that an "intrusive interference" on the part of Deity in *creating* man, and simply *evolving* the other animals from each other, is far more inconsistent with a philosophical view of the origin of life than a steadfast and unvarying adherence to "natural law;" hence if it be admitted that such an exception ever was made, the creative theory is best suited to philosophical thinkers. "*Aut omnis aut nullus.*"

Zoologically speaking, the apes are no nearer man than several other species of animals, unlike in form, either mentally or physically, since they do not belong to the same genus, family or order. Physically, if any connection could be found to exist, it would probably be directly opposite to that claimed by the evolutionists, since in their natural condition apes are by far fitter for the struggle for life, whether in resisting the attacks of other animals or in withstanding the vicissitudes of climate and weather. Besides this, anatomically speaking, apes differ more or less essentially from man in their brains, skins, skeletons and teeth, and the adaptation of these various parts to the necessities of each animal. In regard to their brains, which differ very widely in size from that of man, it is only necessary to say that while the brain of an ordinary white man measures about 90 cubic inches, that of the Negro 85, that of the lowest order of men as much as 68, and that of the smallest adult human being known, a female Hottentot idiot, 62½ cubic inches, that of the *largest* gorilla is only 32 cubic inches in capacity. Besides this, the difference between the brains of men and apes is most marked in the number of secondary convolutions, which are developed in a different order, *i. e.*, those which appear first in man appear last in the ape. If the development of brain is arrested in a child, causing idiocy, the resemblance to that of the ape is less rather than more striking than if the child's brain had become fully developed.

M. Quatrefages concludes an exhaustive argument on this subject, in which he has summed up the contents of a number of contemporary works, as follows: "With regard to the Simial origin of man, it is nothing but pure hypothesis, or rather, nothing but a mere *jeu d'esprit* which everything proves utterly baseless, and in favor of which no solid fact has as yet been appealed to."

The very oldest human skulls ever found showed a brain capacity of 75 inches, and a shape almost entirely similar to that of the existing Caucasian species; so that there is no evidence from the very remotest period of man's

life on the earth that his brain ever approximated in size that of the monkey; nor even, so far as brain capacity is concerned, that recent man has been developed or evolved from the prehistoric man. In fact, Dr. Broca, President of the French Association at the recent meeting at Havre, in an address on the "Human Fossil Races of Western Europe," declared that of the three distinct races of prehistoric men, the last or latest known, called the race of Furfooz, was not equal in point of intelligence to their immediate predecessors. All these things render it extremely improbable, at least, that the human brain was developed by natural selection from that of the ape or any of the lower animals.

Still further, apes not only fall below *man* in mental power, but below several other animals which are never by the wildest stretch of the imagination associated with him, such as the dog and horse, both of which surpass the highest apes in intelligence and adaptability to surrounding conditions, and none of which could, under any stress of external circumstances, leave the natural line of development and put on clothing to protect themselves against cold, manufacture arms to defend themselves, or make their food, by cooking, more digestible and acceptable; while on the other hand it is very certain that man cannot attain the opposite of these things by natural selection or evolution. Finally, man is separated from the most developed of apes by faculties of mind, such as conceptions of good and evil, right and wrong, beauty and taste for art, reverence for his Maker, and lastly a hope of happiness in the future life, none of which can be experienced by the most exalted brutes. As M. Quatrefages says, "It is not by his body that man has acquired that empire that he possesses, but he owes it to his intelligence, of like nature, but immensely superior to that of animals."

Coming at last to the question of creation or evolution, we find, as before observed, a point blank irreconcileability. There is no compromise on the part of the evolutionists. They deny in a breath both creation and God. Spencer and Tyndall do so without hesitation, and Draper but feebly recognizes the superiority of the Law Maker to the natural laws He has established. To show how the least atheistical of them talks, I will quote a few lines from Draper, who delivered an address on the subject of Evolution before the Unitarian ministers, at their Institute in Springfield, Mass., last month. He says: "The hypothesis of evolution asserts that from one or a few organisms all these that we see have been derived by a process of evolving or development. It will not admit that there has been any intervention of divine power." "The hypothesis of creation asserts that Almighty God called into sudden existence, according to His good pleasure, the different types of life that we see." "Creation reposes on the arbitrary act of God; evolution on the universal reign of law." "As to the origin of organisms, it (evolution) withholds for the present any definite expression. There are, however, many naturalists who incline to believe in spontaneous generation." Speaking of Newton's *Principia*, he says, "it gave undisputable reasons that Kepler's laws are a mathematical necessity. For the finger

of Providence it substituted mechanical force, and thus the reign of Law, that great essential to the theory of Evolution, was solidly established." Speaking of the various stages of embryonic life, from the simple cell to the fully developed individual, he says, "common sense revolts against the idea that these transformations are in the individual due to divine intervention. In that, as in the case of the earth, they must be due to natural law." Again, he says, "Nature never selects, never accepts or rejects; knows nothing about duties, nothing about fitness or unfitness. Nature simply obeys laws." Again when speaking of the genealogy of organisms, he says, "the dominion of law is everywhere manifest. The capricious intrusion of a supernatural agency has never yet occurred." And yet after all this apparent exclusion of a creator, we are asked to believe that the effect of the Evolution theory upon us is to make our "conceptions of the unchangeable purposes, the awful majesty of the Supreme being more vivid." This may be plain to philosophic scientists, but not to the ordinary reader.

Now, in brief reply to Draper, those who oppose the Evolution theory ask why is creation necessarily "*sudden?*" Upon referring to the first chapter of Genesis we find the word "create" applied to only three acts, namely: The creation of the Heavens and the earth, the creation of great whales, and the creation of man in the image of his maker. In all other acts the subordinate words "form," "make" and "build" are used. Now is there anything which necessarily implies suddenness of action in the words "In the beginning God created the Heaven and the earth?" Who can tell how long a period the expression "in the beginning" covers? No theologian of the present day undertakes for a moment to establish as a fact that that the act of creating the Heavens and the earth was instantaneous, but simply that it was clearly and purely an act of creation, and not of forming or making or building up from materials already created. The word defined "create," according to Bishop Ely, one of the most eminent of Hebrew scholars, is "evidently the common word for a true and original creation, and there is no other word in Hebrew which can express that thought."

Who asserts, as Mr. Draper assumes, that "Almighty God called into sudden existence the different types of life that we see?" No theologian that we know of claims either suddenness of call into existence or that all the different types of life that we see were called into existence at the same time, but simply that God created them in his own time, at such periods as he thought proper and wisest, and under such laws as he in his infinite wisdom established.

Further, we claim that the whole theory of Evolution depends at last upon the creative power of God, because even Darwin had to start with one or more organisms which were already created, and evolved all the rest from them, while the most earnest advocates of spontaneous generation have so far absolutely failed to satisfy even such willing, but fair-minded, atheists as Tyndall, that any living organism can be produced spontaneously.

The attributing of the succession of life and the development of species continuously from the simpler to the more complex forms, from the proto-

plasms, through the invertebrates to the vertebrates, and finally to man himself; the attributing of these supposed processes to what Prof. Draper calls "natural law," a "process of evolving or development," the "universal reign of law," and the rejection of "divine intervention" and the intrusion of "supernatural interference" as revolting to common sense, and afterwards the admission that all these things manifest the "unchangeable purposes of the supreme being," seem to my mind a manner of stating the case unworthy of so powerful a thinker. To deny in one sentence the divine intervention, and to call the active exercise of his power in the processes of Nature "capricious intrusion," and in the next to make so broad an admission of the manifestation of his unchangeable purposes, is to destroy the effect of all Draper has said, and to convict him of reasoning in a circle. Spencer and Tyndall do not thus stultify themseles by appearing to place God in a subordinate position to the laws he has made. They boldly adhere to their premises and follow them to their logical conclusions, that there was no creation, that there is no God, but that every step in the phenomena of life can be accounted for without invoking the supernatural, and that even the genesis and development of man's *moral* nature are solely attributable to the interaction of social forces.

In support of the Creation theory we must call attention to the sudden and most remarkable increase of animal forms in that part of the Tertiary age known as the Miocene period, as it is impossible for the necessarily slow development of evolution to have accomplished it. The few mammals found in the beds of the previous or Eocene period are comparatively unnoticeable, but when we turn the corner, as Prof. Williamson says, "it appears as if some great magician had waved his wand and in response to the magic summons, life of the most varied character and in forms most dissimilar to what immediately preceded, flash into existence," and as he further says, "this unexplained outburst of new life demands the recognition of some factor not hitherto admitted into the calculations of the evolutionist school."

One of the most striking proofs of the truth and correctness of the Evolution theory is claimed to have been recently perfected by the discovery of the remains of the Eohippus in the lowest Eocene of the Tertiary deposits of Western Kansas, by the celebrated American naturalist, Professor O. C. Marsh. This Eohippus is claimed as the original progenitor of the modern horse, having four complete toes and a rudiment of the fifth on the front feet and three behind. In size not exceeding a fox, and with 44 teeth, this horse, imperfect as he is, holds the place of the apex of the Pyramid of Evolution, the crowning glory of the series which terminates in a domestic animal so indispensable to man that these same evolutionists account for man's earlier absence in different portions of the earth by the absence of the horse. Is it not strange that we find no evidences in ancient or modern times that our progenitors, the apes, ever made any use of this indispensable animal?

The next higher representative of the horse is found in the more recent Eocene, and has lost the rudimentary toe of the front foot, and has also secured a change of teeth. This link, which is called Orohippus, is but little larger than Eohippus, and shows a greater though still distant resemblance to the modern horse.

Near the base of the Miocene a third closely allied genus named the Mesohippus is found, which is about as large as a sheep and one stage nearer the horse, having but three toes and a rudimentary splint on the fore foot, and the teeth are still changing.

In the upper Miocene a fourth form is found, the Miohippus, which is larger than its predecessor and has its three toes more nearly of a size.

Coming to the lower Pliocene, we find the next step represented by the Protohippus, which is yet more equine and grew to be as large as an ass. Still retaining the three toes, it differs from the others in having only the middle one long enough to reach the ground, similarly to the Hipparion of Europe. Still ascending in the Pliocene, we find the Pliohippus, which is the last in the series before reaching the true horse, having lost the outside toes and become in other respects equine. In the upper Pliocene we find Equus himself which roamed in the Post Tertiary period over both Americas.

This seems, in its general aspects, a very complete and satisfactory genealogy, and it has proved so to Professors Marsh and Huxley, the latter of whom was especially gratified and delighted upon first seeing Prof. Marsh's specimens at New Haven. But when it comes to be subjected to the critical test of Evolution and Natural Selection themselves we find many links wanting; when we scrutinize these alleged continuous changes from the four-toed Eohippus to the one-toed horse of the present day and ask in what respect was the animal benefitted by the changes, and where is that gradual alteration which the necessities of each individual demanded in his own person, the answer still comes, not fully accounted for! We lack proof that this digital reduction was caused by the peculiar manner in which the mechanical strain operated upon the foot of the horse, as is claimed by Prof. Ryder, in a recent article written for the *American Naturalist*, because other animals, as the elephant and ox, using their feet in the same manner and probably dating back as far in the history of the earth as the horse, have respectively five and two toes. We also lack proof that the original four-toed Eohippus was descended or evolved from any previous animal. As Prof. Marsh says himself that he can offer no better illustration of the progress in vertebrate palæontology than this, we may hold it up as the best demonstration of their theory that the evolutionists have yet found, and ask how conclusive it is and how imperfect it is?

Per contra, I will quote a few lines from Clarence King, who has explored the Tertiary formations of Western America with the same zeal and earnestness, and the same scientific care and philosophical spirit as Professor Marsh. He says: "Those two authorities (Huxley and Marsh), whose knowledge we may not dispute, assert that the American genealogy of the

horse is the most perfect demonstrative proof of derivative genesis ever presented. Descent they consider proved, but the fossil jaws are utterly silent as to what the *cause* of the Evolution may have been. I have studied the country from which these bones came, and am able to make this suggestive geological commentary: Between the two successive forms of the horse there was a catastrophe which seriously altered the climate and configuration of the whole region in which these animals lived. Huxley and Marsh assert that the bones prove descent. My own work proves that each new modification succeeded a catastrophe. And the almost universality of such coincidences is, to my mind, warrant for the anticipation that not very far in the future it may be seen that the Evolution of environment has been the major cause of the evolution of life; that a mere Malthusian struggle was not the author and finisher of evolution, but that He who brought to bear that mysterious energy we call life upon primeval matter, bestowed at the same time a power of development by change; arranging that the inter-action of energy and matter, which make up the environment, should from time to time burst in upon the current of life and sweep it onward and upward to even better and higher manifestations. Moments of great catastrophe, thus translated into the language of life, become moments of *creation*, when out of plastic organism, something nearer and nobler is called into life."

Now, let us see how the advocates of Evolution agree among themselves. Mr. Clarence King, who is referred to above as the latest advocate and reviver of the catastrophic means of accounting for missing links in the chain, thus speaks of Mr. Darwin's theories: "Whatever change takes place by Natural Selection in uniformitarian ages, according to Darwin advances by spontaneous, aimless sporting, and the survival of those varieties best adapted to surrounding conditions, and of these conditions the biological relations are by far the most important of all. By that means and that alone, it is asserted, species came into existence, and inferentially, all the other forms, from first to last. This is the gospel of *chance!*" Having thus given his opinion of the Natural Selection theory, he proceeds to give his own view of the continuity of life through and beyond one of his catastrophes in Nature, thus: "When catastrophic change (as for instance from the Palæozoic to the Mesozoic period) burst in upon the ages of uniformity and sounded in the ears of every living thing the words 'change or die,' plasticity became the sole principle of salvation. Plasticity, then, is that quality which, in suddenly enforced physical change, is the key to survival and prosperity. And the survival of the plastic, that is, of the rapidly and healthily modifiable, during periods when terrestrial revolution offers to species the rigorous dilemma of prodigious change or certain death, is a widely different principle from the survival of the fittest in a general biological battle during terrestrial uniformity. In one case it is an accommodation between the individual organism and inorganic environment, in which the most yielding and plastic lives. In the other it is a Malthusian

death-struggle in which only the victor survives." * * * "At the end of an interval of accelerated change only the most plastic would have deviated from their late forms and reached the point of successful adaptation, which is survived in health."

Prof. Cope differs from King altogether, rejecting his theory that catastrophic disturbances produce great destruction and re-introduction of life, and ascribes the sudden appearance of new species wholly to migration.

I have also been informed by a most reliable gentleman that one of the most distinguished geologists of the west, who has been associated with Prof. Marsh in most, if not all, of his explorations among the fossil remains of Kansas and Colorado, not only refuses to accept the Evolution theory, but on the contrary claims to have found many facts that convince him that it is untenable. Thus we find that the evolutionists themselves cannot harmonize even in their theories, although necessarily based upon the same facts, and that those who labor with them sometimes fail to agree with them; whence, we again conclude that the natural laws of progression offered us as a substitute for creation are by no means so clear that one who runs may read; at least all may not read alike.

I have now gone pretty much over the whole subject, and while I have omitted much that might have been said, I feel that in view of the admissions of the imperfections and the incompleteness of the theory of Evolution by Huxley, Darwin, Marsh and others, and their hopeful reliance upon the developments of science in the future for its perfection, we may rest our case here until the objections pointed out have been met, and also rely upon the Providences of God, explained by the unquestionable proofs obtained by impartial scientific research, for enlightenment as to his inscrutable acts in the past, as well as his unchangeable purposes for the future.

MEDICINE AND HYGIENE.

NEAR SIGHTEDNESS IN SCHOOL CHILDREN.

BY PROF. J. M. GREENWOOD, KANSAS CITY, MO.

Of late years scientific research in the various departments of human thought has set in motion a mode of mental activity that makes free to question all phenomena whether physical or material. It was in this spirit of inquiry that Prof. Donders, some thirteen years ago, made a statement which has since attracted considerable attention in Europe and also in America. He was of the opinion that if a definite number of students, say, of a university, should have their eyes examined at regular intervals during their course, the statistics thus obtained would indicate aston-

ishing results in regard to the wide-spread prevalence of near sightedness among such a class of persons.

The object of this essay is to trace briefly the results of some observations made to test Prof. Donders' statement; secondly, to give a brief account of the causes of near sightedness and the remedies therefor as advocated by others; and lastly, to present such opinions as I have formed in regard to this disease of the human eye.

These divisions, for convenience, will be discussed in the order enumerated.

Two years after Prof. Donders made his statement, Dr. Cohn, of Breslau, published the results of the examination of thirty-three schools, including the university. The examination embraced 10,160 pupils, 1,004 of whom were near sighted, and only 28 of them had near sighted parents. Only one in twenty-five of the children the first half year in school was found to be afflicted. The examination was confined to biennial grades and extended over a period of fourteen years of school life. The longer the pupils had been in attendance the greater the percentage of increase and of those having been in the school fourteen years, 63.6 per cent. were near sighted.

Recently Drs. Loring and Derby examined 2,265 pupils in the city schools of New York. The proportion of natural shaped eyes among the children between six and seven years of age was 87 per cent. and of those twenty to twenty-one, 61 per cent. In St. Petersburg, pupils of the same ages in school as the American children were found in the first class, 13.6 per cent., and 43 per cent. in the latter. The percentage in the Königsberg schools in the corresponding classes was 11.1 in the former and rising in the latter to 62 per cent.

In the college of the city of New York, 549 students were examined and the following results reported: Introductory class, 29 per cent.; freshmen, 40; sophomore, 35; junior, 53; and senior, 37 per cent.

An examination of 300 students in the Brooklyn Polytechnic School showed 18 per cent. in the academic and 28 per cent. in the collegiate department.

There were 630 pupils examined in the Cincinnati public schools: In the district schools ten per cent. were purblind; in the intermediate grades fourteen per cent; and eighteen per cent. in the high and normal schools.

Last February, Dr. Lucien How was appointed to examine and report on the public schools of Buffalo, which he did in the following March. Dr. How examined the eyes of 1,003 pupils—20 per cent. he reported short sighted and 12 per cent. long sighted. No pupils six years old and under had defective eyes; but at seven he found 5 per cent. purblind; at eleven, 11 per cent.; at thirteen, 19 per cent.; at eighteen, 26 per cent., and those over twenty, 43 per cent.

All of the conditions of this examination were carefully noted, and may be classified under the following sub-divisions: 1. The precise condition

of the pupil's vision. 2. The position of the body. 3. Illumination of the school room. 4. Relaxation of the eyes or body for long or short intervals. 5. Hygienic conditions.

In the city of New York the percentage of the children was recorded with regard to nationality. The nationalities represented—German, American, and Irish, and with the following results, viz: German, 24 per cent., American, 19 per cent., and Irish 14 per cent.

Dr. Peter A. Callan examined 457 colored pupils in schools Three and Four of the city of New York, and found but 2.6 per cent. of the pupils near sighted, although their ages were from five to nineteen.

The first and second divisions may be condensed into the following extract from the November number of the *Popular Science Monthly:*

"Resuming now the consideration of near sight, we proceed to suggest some of its principal causes, as follows:

1. Too early use by school children of books, slates and writing paper, or copy-books, when black-boards and models would be better. Type and script letters and figures and their primary combinations, at least, should never be taught from books, but from large and perfectly formed models, printed on cards and hung on the wall. When the eye and the memory are sufficiently trained to easily recognize and name each letter and figure at sight, and when some knowledge has been gained of the power of letters and figures in combination, then the same forms in books will be at once familiar as old acquaintances, and may be studied without straining the sight. To train the hand without straining the sight presents a great practical difficulty. In the large schools, of course, all the children can not go to the black-board; but a considerable practice in drawing large lines and simple objects on good sized slates, in a sort of free-hand style, should precede the formation of letters and figures, and when these are begun they should be made of generous size. A correct position, meanwhile, should be an imperative requirement; and, until it becomes habitual and easy, good work should be held to be of secondary importance. Hard slate-pencils and greasy slate surfaces should not be permitted; both should be subject to systematic inspection.

2. Ignorance or laxity on the part of parents and primary teachers in permitting faulty positions of the head, body and book during reading, study and writing, and in not seeking early to secure the intelligent co-operation of the pupil by simple and appropriate physiological instruction.

3. A prolonged and steady looking at an object or at objects near the eye, though at proper distance, without rest or frequent change of the visual focus, as in long and absorbed novel reading, intense study, or persistent diligence in needlework.

4. The practice of reading or otherwise using the sight at too short range. This results in part from insufficient light, or from its faulty direction, so that the hand or body throws a shadow on the page, or so that the direct rays fall upon the eye, causing undue contraction of the pupil, while

the page is in the shadow. It results also from improperly graded desks, from small and poor type and inferior printing-ink, and from faulty color and quality of printing-paper; also from pale writing-ink—pale when used—and from the substitution of the lead pencil for the pen, especially in the evening.

5. A prone or forward position of the head too long maintained or frequently repeated, and becoming a habit. This results from reading or studying with the book in the lap and from the use of desks not graded to the height of the pupil. Dr. Howe reports pupils varying eighteen inches in height seated at the same grade of desks. The distance of the eye from the page should not be less than twelve nor more than eighteen inches. Having the desks set too far from the seats also induces this faulty position. The front of the desk should overlap the seat one or two inches.

Donders says: 'In the hygiene of myopia the very first point is to guard against working in a stooping position.' He favors high, sloping desks, and indicates 'rectilinear drawing on a flat surface' as a class of work which is especially objectionable.

6. Since a vitiated atmosphere is a frequent feature of the school room, it may not be amiss to add here that the effect of bad air is indirectly to injure, if not to destroy, the sight."

Three kinds of eyes are recognized in this discussion, namely: Normal, near sighted and long sighted. The first brings the rays of light to a focus on the retina; the second, in front of the retina; and the last, behind it. The difference in eyes consists chiefly in the direction of the axis of the eye from front to back, and also in the convexity of the crystalline lens.

A pertinent question is, what change, if any, is produced in the shape of the eye to accommodate it to objects whether near or remote?

To explain how near sightedness is produced, some contend that when the object is near, the muscles that turn the eyes toward the nose press on the eyeballs, elongating them and consequently increase the elliptical form of the crystalline lens, and that this is the cause.

Admitting this to be correct, how can it be demonstrated? is a question that will puzzle, I apprehend, the author of the article in the *Popular Science Monthly* as well as Dr. Wm. Dickinson, who has written on the same subject in the *American Journal of Education*. The question thus presented is, How does the eye adjust itself? By external pressure of the inside muscles? By a forward or retrograde movement of the crystalline lens between the aqueous and vitreous humors? Or by contractions and relaxations of the suspensory ligaments and ciliary muscles?

Let us proceed to test these theories.

Hold the flame of a candle near a person's eye and a little to one side, and look into the eye from a proper distance, and three images of the flame will be seen, two upright, and one inverted. The cornea reflects one upright image, and the front of the crystalline lens the second, while the third is reflected from the concave surface of the back part of the crystalline lens.

Now let a person look at a near flame and then look at one greatly removed, but in the same line of vision, or *vice versa*, and the first and third images remain unchanged. If it were the external pressure of the muscles which changed the shape of the eye, the flame from the cornea would have exhibited a different form, but no such change can be detected, nor is there any difference in the third image. As the question is now narrowed down, the change is found to be in the frontal portion of the crystalline lens, and hence the outside muscular pressure theory must be abandoned.

That the lens by some process unknown, but imagined, moves itself bodily backwards or forwards between the two humors is, to say the least, untenable; neither can it be that the muscular contraction or expansion of the iris, owing to the intensity of light, is the cause, for the iris may be removed and vision not be impaired.

Having dismissed the external and the movement theories as inadequate, the last appears to fulfill the necessary conditions, to-wit: The lens is kept in position by the suspensory ligaments, and is therefore somewhat flattened out. Now when the ciliary muscle contracts it relaxes the ligaments and the lens becomes more convex, and returns to its former shape when the muscle relaxes again. It will be observed that the frontal portion of the lens only is made more or less convex, and the convexity depends upon the distance the object is from the eye.

A MORE GENERAL STATEMENT.

Notwithstanding the testimony of the learned gentlemen who have written and adduced bewildering statistics on near-sight, I believe that the so-called causes are effects of remoter causes that they have strangely overlooked in the multiplicity of details.

The world is governed by law, which is only another name for uniform influences that produce definite effects. Of the animal, we speak of the law or conditions of growth, and we summarize the whole process in three words—food, exercise, and rest. Without proper food no animal functions can be long sustained, and to give intensity and activity to effort appropriate exercise is necessary—yea, indispensable,—and without regular intervals of rest the sturdiest organism is soon worn out.

To draw universal conclusions from the particular cases examined is not the safest mode of reasoning, and yet it is evident that the general drift of the investigation, so far, establishes the fact that the more highly civilized the society and the more universal the culture, the greater the tendency to near-sight. The same process of reasoning would seem to warrant the conclusion that when all people become cultivated, perfect sight will be a thing of the past.

But there are modifications of these premises which should not be omitted in drawing inferences.

An analysis of 26,000 cases reported would indicate (1), that nearly all cases of near sight originate in the school-room; and (2), that the number in-

creases rapidly the longer the pupils are in school; also the analysis enables us to group those examined into a few classes, namely: white pupils, colored pupils, artisans, laborers, and professional characters. The examinations, however, have been confined almost exclusively to white children.

Let it be borne in mind that the white children examined lived in cities, probably a large number of them never lived elsewhere. These children have had a restricted range of vision and owing to the smoke in the atmosphere hovering over the cities where they lived, it was impossible for them to see objects at any considerable distance. These restrictions impose conditions which superinduce near sight, and owing to the presence of these limitations may be attributed that abnormal state of the tissues of the eyes, rendering them easily susceptible to extraneous influences; in other words, the eyes of such have not the power of resistance. External circumstances conspiring, the usual treatment of the school precipitates the disease. It is suspected, furthermore, that during the transition or formative period food plays no unimportant part in enfeebling the action of the visual organs. Repeatedly experiments have shown that food will not only change the composition to some extent of the tissues, but will even change very materially the nature of the animal itself.

The presence of this disease, then, is due largely to a general enfeeblement of the organs of sight, caused primarily by the want of appropriate exercise and the lack of nutritious food, either or both of which would be sufficient to produce derangement of the eyes. Every organ of the body is made stronger and healthier by appropriate and regular exercise, and the eye is no exception to this rule—the testimony of the observant everywhere and our daily experience confirm it. The hunter on the far-off plains, the sailor on the ocean, the boy on the farm accustomed to look at distant objects, the herdsman with his droves and flocks, the sharp-shooters picking off the cannoniers, the colored children watching the flights of birds till lost as specks on the sky, all these teach the educability of the eye and that it is subject to law. Non-use then has impaired the sense of sight. Abuse in schools, as will be presently shown, is working sad havoc on the pupils' eyes, but even then it must be viewed as an afterthought.

Schools and school-houses are eye-traps, owing to the mode of management in them, yet there are exceptional cases which it would be manifestly unjust to include in the general statement. As it is, year after year natural conditions are violated, till the alarming extent of the disease proclaims in arithmetical arguments the amount of damage done.

In visiting the schools of St. Louis, Cincinnati and Boston—these are chosen as representative cities—I was surprised at the little use made of the blackboards. It was a matter of astonishment, and I ventured on several occasions to ask for what purposes the boards were used. Some rooms visited in the month of May had pictures on the boards drawn the June before. These pictures were for ornamentation, and were on the boards where the pupils ought to work daily. The pupils recited generally from their books

or read their lessons from slate or paper. And in the more advanced classes —in the high school department—the rule, so far as I could see and comprehend it, was to send one pupil only to the board at the same time, while the others figured on slates or paper, as directed by the teacher. So many boys and girls wore glasses in their classes that verily I thought it a fashionable indication of respectability.

Summing up the results of the blackboard work in the schools of this class, it is forcibly expressed in legal parlance, thus: "Brains versus Chalk." But the proper form, however, is: "Brains and Chalk make the successful school teacher," and this emphatically embodies the kernel of truth upon which all teaching depends.

Owing to the limitations thus imposed upon school work the pupils are forced to work at a great disadvantage, the same muscles of the eyes for hours are kept in a constant tension, and the exercises are not varied to give relief or to counterbalance the undue strain. There is a path of safety and lies in the direction of variety. The board must be used more frequently. The pupils must put aside their books whenever practicable, work at the board, and during explanations scan the exercises on the board across the room. Calisthenic exercises in looking at distant objects will, in a few years, be a daily drill. By introducing variety in work and exercise the pupils' eyes will be injured but little.

Near sight is seldom found after sixteen or eighteen years of age, hence it is confined chiefly to those who have been students from early life. Seamstresses, watch makers, lawyers, engravers, &c., show a small per cent. compared to the studious. Their eyes were not distorted in early life, hence their freedom from it in old age. According to the theory now advanced there would be less near sight in new countries than in old; less in smaller cities than in large ones; less in prairie countries than in timbered; less in those who exercise their eyesight on distant objects than those who do not, and coming down to Kansas City, less in Lincoln, Woodland and Morse schools than in the other schools; less in proportion to the school population here than in St. Louis, Chicago and New York.

The report of the colored schools confirms this view. The range of vision of those children had not been shut in. They have inherited no flabbiness of tissues as in the case of the less fortunate white children, and besides the negroes have enormous curiosity which they seek to gratify at all ranges; and further, the occupations of this race have not been such as to superinduce the disease.

In conclusion, I would suggest the propriety of having medical experts examine and report on the schools of the city.

There are certain reasons why such a report would be desirable. In the first place, it would give data for solving the educational problem, and since the schools of Kansas City do more blackboard work than any other city in proportion to the enrollment, that would be a new factor, and third, it would prove or disprove the predictions in this paper.

XUM

ELECTRO-MAGNETIC QUACKERY.

In this last quarter of the nineteenth century we are accustomed, and with good reason, to believe the reign of superstition at an end. It is true that the Astronomer-Royal still receives an occasional communication from some love-lorn maidservant, asking him the lowest "figure" at which he can work the stars in her behalf, or from some alarmed countryman begging him to arrange the spheres into a conjunction favorable to his cows' disorder; but such exceptional cases are very rare, even amongst the most illiterate classes of England, and other civilized countries. The business of the witch has become extinct, and fortune-telling is punished by imprisonment. Supernaturalism has given place to science, and the spells of magic to the reign of law. But although the witch no longer exists, and the fortune-teller is dragged to jail, the crop of charlatans who prey upon the ignorant and credulous is not thereby diminished. The snake is scotched, but not killed; and the ancient Necromancy comes forth in a bran new skin as Quackery.

From their marvellous results and occult effects, electricity and magnetism are marked out as the instruments of the quack. We are, of course, far from wishing to imply that electricity has not proved itself a serviceable agent in medicine and surgery, and that there are not further triumphs in store for it as a healer. We wish here to deal, not with its legitimate practice by the faculty, but with open and manifest quackery.

Of the hundreds of pamphlets and advertisements circulated throughout the country to set forth the wonderful virtues of electric and magnetic curatives, on the "gentle current" principle, it is easy to recognize certain general features. They are usually headed by some striking motto, such as "Electricity is life" (a statement, by the way, which practical electricians may be inclined to call in question in these dull times); and garnished by bar magnets radiating "lines of force" in the most refreshing and stimulating manner, but in curves, which we need hardly say, were never drawn by Faraday. The various curative systems are distinguished by such names as "Polymagnetica," "Skeuasma," "Amynterion," "Magnetine"—titles which at once satisfy the prevailing taste for classical terminology in new inventions, and lend a foreign air pleasing to the fancy, like the Circassian dress in which Mr. Maskeyline clothes his automaton "Psycho," or the Italian and Mexican pseudonyms frequently adopted by trapezists. Sometimes the author of a pamphlet rises with the glory of his theme, the "Skeuasma" or the "Amynterion," into a true state of what Prof. Clifford would call "Cosmic Emotion," and blends poetry with his science. "Electricity," says one inspired writer, in treating of the "Magnetic Spine Band" and "Knee Cap," "electricity is the prime factor in chemical action, and in all atmospheric changes; it influences the production and growth of plants, and is essential to the life of every living thing. Where, indeed, is this subtle and powerful,

though invisible agent, not at work? It pervades universal nature, and may be said to hold the Universe in its grasp. It unites one particle of matter to another, binds world to world and system to system. * * It deposits the precious metal in the veins of the rock, gives its beautiful symmetrical form to the crystal, and paints the flowers of the field; and, while it awes us in the flashing lightning and crashing thunder, lights up the gentle Aurora Borealis in our winter evening sky."

We have before us as we write a few of these pamphlets and advertisements. There is, for example, the "most marvellous half-crowns-worth in the world, the Electric Star," which is to be worn on the chest or spine over one garment. "The warmth of the body will be sufficient to excite the current, which should not be felt or but very slightly. If, however, the current be too strong, it must be muffled with an extra thickness of flannel, which changes its action to a 'quantity current' (less intensity)." This beneficent star is to be obtained at the railway stations. The magnetic system of cure, of which there are several varieties before us, are all based on the simple fact of carrying a magnet on the person. These magnets are made up into belts, spine bands, gloves, necklets, &c., for local application to the affected part. They are an almost infallible remedy for the whole gamut of human ailments from teething and whooping cough to gout and paralysis. The physical cause of the curative powers of magnetism is not far to seek. We are told in one of these pamphlets that "it is one of the most clearly demonstrated truths of science that magnetism is one of the forms of electricity; and that magnetism as easily and naturally becomes electricity, when absorbed by the living forces of the human frame, as water becomes vapor or steam by the absorption of heat. The human frame, moreover, absorbs magnetism when brought into connection with it, as easily and naturally as the plant absorbs nourishment from the soil in which it grows. * * Magnetic currents entering the human frame, are absorbed by the blood which carries in it a large portion of iron, and (in the arteries) also of oxygen, both of them are highly magnetic. As they circulate in the body, therefore, they answer the same purpose as the coils of wire in the magneto-electric machine. They attract and absorb the magnetism. The magnetism thus drawn by them into the blood, becomes an electric current in the blood, increasing its vitality and thus conveying fresh life and energy to every part of the frame." A remedy like this which renovates the blood itself cannot fail to be very comprehensive in its efficacy. As an instance of the kind of infirmities to which it is applicable besides all the principal diseases, we give another quotation: "Try a magnetic pad on a child that is restless and fretful during the night, and the relief experienced will soon speak for the value of the remedy. Persons in good health, but exposed to infection, or constitutionally liable to forms of disease, could hardly fail to find themselves secured by wearing a magnetic belt or spine band, accompanied by the daily use of the magnetic friction glove. So with others who would probably say they are in good health, but who are liable to depression of spirits. * * Few sufferers need despair of obtaining relief."

The fictitious properties of these magnetic appliances are not without the support of many testimonials some of which are from clergymen. If these published recommendations are authentic we can only wonder at the extraordinary power of faith as a healing agent.

In one of the pamphlets attention is drawn to the "Magnetic Pavement," for the prevention and cure of disease in horses (we presume the magnetic power of this wonderful invention acting on the iron shoes of the horses would not be sufficient to fix them immovably in their stalls), oxen, sheep, &c. Surely the height of absurdity is here reached.

The examples we have given will show that it is no phantom we are attacking, but a wide-spread and flourishing system. While the fortune-teller, the public spiritualist, and the card sharper are dragged to justice, the plausible brood, who in this way delude the simple and the poor, are left at liberty and even protected in their evil practices by Her Majesty's patent laws. Their day, however, is happily drawing to a close. A true education will remove the ignorance necessary to their subsistence. The next generation, we trust, will kill the snake outright, and bury it in that Limbo, to which sooner or later, all Quackery must come.—*London Telegraphic Journal.*

THE DANGERS OF ANÆSTHETICS.

BY A. H. TREGO, D. D. S., KANSAS CITY, MO.

A recent fatal result from use of Nitrous Oxide Gas has caused considerable excitement and exaggerated comments. To say the least of it, it is preposterous for any one to assert that there is "no danger" in depriving the human organism of all sensibility by use of anæsthetics. It is claimed that fewer deaths have resulted from "gas" than from chloroform or ether. This is explained by the fact that fewer persons (in proportion) have been made insensible by its use It is almost impossible to get a nervous patient, or one with weak lungs, to breathe sufficiently rapid to become entirely anæsthetized by nitrous oxide. Professor Zeigler says the effect of nitrous oxide gas is "the point beyond superlative exhilaration." For instance, a horse is trained to trot at the rate of 2:18, you urge him to that point and by further urging he breaks, becomes demoralized and insensible to outward influences. Horses have died on the track from superlative exhilaration.

The fatal cases from nitrous oxide seem to have been patients who were susceptible to sudden death from any unusual excitement—as fright, overexertion or the anxiety natural to having a dreaded operation performed. The anæsthetic simply drove the circulation to a point beyond its normal capacity. This condition of exhilaration applies more especially to gas, as with chloroform and ether the effect is mere narcosis. More bad effects result from gas than from other agents, in proportion, on account, undoubt-

edly, of its supposed safety and of unscrupulous operators. In larger cities the gas business is done where they make extracting teeth a specialty, and patients are rushed through the mill regardless of health, nerves or condition. In smaller towns it is impracticable and non-paying, and the gas is liable to be stale or impure. Under either circumstance it is excessively uncleanly to inhale from a bag that others have exhaled their fœtid breath into.

Only a small portion of gas is taken up by the lungs at each inhalation, and all that is exhaled is carbonic acid gas, which soon poisons all that is in the bag. Hence, it is not improper to infer that the patient, when insensible, is as near asphyxia as anæsthesis.

Syncope is a misnomer for the alarming symptoms produced by ether. When death results from inhaling ether the heart continues to beat several minutes after respiration has ceased, thereby giving due warning of danger and making ether comparatively safe.

Loud breathing (snoring) proceeds from inertia of the palate, and should be carefully watched. If it stop suddenly stop the ether and apply restoratives.

Chloroform is more volatile, more powerful, and the danger exists in sudden action upon the heart. Experienced, unhesitating operators will readily detect danger when the patient has taken a few inhalations.

The colleges and hospitals have adopted as a standard, one part chloroform to two or three of ether, the mixture being more active and more readily thrown off. There is no authentic case where any patient has died from anæsthesis by the use of this mixture. There is danger that a cheap and supposed-to-be safe anæsthetic will be introduced, in which case America is liable to become a toothless community.

Moral—Don't allow your teeth to require extracting.

GEOLOGY AND MINERALOGY.

THE STE. GENEVIEVE COUNTY COPPER MINES.

The copper mines described at length below are now becoming quite widely known, consequent on shipment East of their ores and the recent construction of a copper furnace at Ste. Genevieve, in which the copper ore is now reduced to the condition of black copper, and in that condition shipped eastward for refinement.

ST. LOUIS, MO., June 8, 1877.

Messrs. Rozier, Harris & Co., Ste. Genevieve, Mo.:

GENTLEMEN—I herewith submit my report upon the "copper lands" belonging to Messrs. Rozier, Harris & Co.:

The property is situated in the county of Ste. Genevieve, State of Missouri, in and about ten miles west of the town of Ste. Genevieve, which is on the Mississippi river, sixty miles below St. Louis.

Topography.—The county is undulating, with hills from 150 to 200 feet in height, with here and there valleys sufficiently wide for agricultural purposes. The limestone constituting the substructure of the hills is covered with a deep soil; but here and there the soil has been carried away by erosion, laying bare the rock, and in many places leaving a seam of copper ore exposed.

Geology —The geology of the copper ore district belongs to the Upper Silurian formation which extends far to the West and reaches within a few miles of the river on the East, at which point the "Carboniferous system" occupies the intervening district to the river. The copper ore occurs in three, possibly four, distinct beds.

The Harris Mine.—The copper ore at this point occurs in three beds; the lower bed is situated far down the hillside, and as yet is not developed; the middle bed which is by far the most important, occurs on or about the 75 feet contour line of the hill; this belt lies horizontal, and between the layers of limestone. Immediately below the ore bed is a stratum of quartz or flint of several inches in thickness; then the hard, dense limestone. Immediately overlying the ore bed is another thin stratum of flint, and then the Silurian limestone, which extends to the top of the hill. Near the summit of the hill the third ore bed occurs, which, like the first, is undeveloped; but both the first and third promise upon further development to equal in quantity and quality the middle deposit of ore.

As the three deposits are so similar in their character, both mineralogically and geographically, a description of one will answer for the others: The ore bed proper is a horizontal stratum between the limestone beds, undulating with them and partaking of their folds, and though the folds are continually changing, they remain almost at a uniform level. The ore bed changes in thickness from six or eight inches to several feet; and on measuring the beds at a number of points, I consider a foot in thickness a low average. Near the surface in the clay and on the exposed rocks the ore has to a great extent been transformed into green and blue carbonates; but as the hill is penetrated the sulphuret occurs, mixed with carbonates and red oxides; and at a distance of 100 feet the carbonate gradually diminished, being replaced by red oxide with considerable sulphuret. The experience at every point has been that the ore increases in richness and quantity as the hill is penetrated, not unfrequently being several feet in thickness of almost pure red oxide and sulphuret.

The mines are invariably free of water, no trouble being experienced except immediately after heavy rains; and this trouble can soon be obviated as the mines admit of a fine system of drainage, as tunnels can be run into the hillsides, draining off the waters into the valleys below.

The percentage of the ore varies very widely, according to the character

of the ore. Two green carbonates, mixed with silica, respectively gave 13.72 per cent. and 17.69 per cent. One specimen of green carbonate, 28.51 per cent. A number of red oxides ranging between 33 per cent. and 35 per cent. One of pure green carbonate gave 40.28 per cent. The average selected ores range from 20 per cent. to 30 per cent. A very large amount of ore, probably 1,000 tons, is on hand, averaging 10 per cent., not shipped, being considered too low a grade; but with proper handling could be smelted at a profit.

The Chicago Mine.—The Chicago mine is situated on the same hill, and is almost identical in every respect with the Harris mine; in fact, the above description answers both, and I had both in my mind when writing this report. This mine is much farther developed than the Harris mine, showing the same character of ore.

A number of drifts have been run into the hill to depths ranging from 50 to 165 feet, the ore gradually increasing in richness and quantity as the hill is penetrated; about 300 feet of drifts have been run, averaging a height of 5½ feet and a width of 5 feet.

The character of the ore and rock renders mining very easy; and the mixture of the carbonates, sulphurets and oxides are such as to make them very desirable for smelting. These ores are bought at a furnace at Ste. Genevieve, the price paid being according to the percentage of the copper contained in the ore, ranging from $25 to $100 per ton, delivered in Ste. Genevieve. To mine and deliver the ore, including all expenses, it costs about $25 per ton.

The roads are in fair order; the road bed being partly of rock, but principally of red clay. With a small outlay of money and work these roads could be put in a good condition. At present a ton to a two-horse team is a fair load.

The property consists of 80 acres (in fee simple) and the mining lease for 20 years, on about 250 acres of land, the whole tract being contained in hill described, and no doubt underlaid by at least three, and probably four, ore beds.

From the large quantity of ore already proved to exist in the hill by numerous tunnels and shafts, the richness of the ores, the readiness with which they are smelted, the facilities of transportation to market, and the great demand for the ores, the property is of great value.

Very Respectfully, etc., JAS. R. GAGE.

THE GEOLOGICAL RELATIONS OF THE ATMOSPHERE.

The gaseous envelope which surrounds our globe plays a very considerable part in the chemical changes ever going on in rock formations, whether actually at the surface—as in what is called the "weathering of rocks"—or in the less apparent, but perhaps more powerful, action carried on below the surface. In a late number of the *Quarterly Journal of Science*, Edward

T. Hardman, F. C. S., has a very exhaustive paper on "The Atmosphere Considered in its Geological Relations," from which we extract the following interesting facts:

Perfectly pure water has a very appreciable solvent effect on rocks, which is immensely augmented when it is chemically charged with carbonic acid, oxygen, nitric acid, and other matters derived directly or indirectly from the atmosphere. But while on the one hand the influence of the atmosphere disintegrates and destroys rock masses, on the other it is mighty in building them up. Without the small percentage of carbonic acid contained in the air there could be no vegetation, and there would be none of the coal beds which form such important members of our rock formations. The immense masses of limestone found everywhere, and the coral reef of the present day, must owe their being indirectly to the carbonic acid of former atmospheres. A drop of rain water absorbs a trace of carbonic acid from the atmosphere, falls on a rock containing lime in some form, dissolves the lime as bicarbonate, carries it down to the ocean, and finally gives it up to become part of the skeleton of a coral or mollusc, which in its turn may form a portion of an immense mass of limestone rock.

The bulk of the atmosphere is made up of oxygen and nitrogen, but these do not take so active shares in geological matters as the almost infinitesimal trace of carbonic acid present. The amount ranges from 3 to 10 volumes in 10,000 volumes of air. The principal sources of increase are volcanic and other subterranean exhalations; respiration of animals; combustion of fuel and vegetable decay.

The series of rock-metamorphisms due to the simple absorption of carbonic acid by a plant is very interesting. The carbon is assimilated by the plant, and it dies and becomes thus a part of a coal bed or lies embedded in sediment of some kind. Decomposition sets in; and if there be a reducible compound near it, chemical changes result. If the strata contains sulphate of iron, it is reduced to sulphide, commonly known as iron pyrites or false gold. The reduction is effected by the carbon of the plant abstracting the oxygen from the sulphate. The resulting carbonic acid either is taken up by percolating water and penetrates farther into the heart of the rock, effecting new changes, or it finds its way to the surface through some crevice, or by aid of a mineral spring, and once more mingles with the atmosphere, to be perhaps again absorbed by vegetation and pass through a similar round of changes afresh. In many cases the action of the carbonic acid changes a metallic ore from an insoluble to a soluble compound, thus reducing the ancient crystalline rocks. The metals carried away by streams were deposited along their beds, and valuable beds of ore were formed.

The atmosphere in the carboniferous age contained a much larger portion of carbonic acid. This has been gradually absorbed into the earth, until the amount stored in the earth is estimated at 6,620 times as much as there is in the atmosphere, although the latter contains 1,250,000,000,000 tons of

carbon. All animal carbon is derived from the atmosphere. Say a tiger dines off a cow, the carbon and nitrogen of her flesh have been obtained from vegetation, which in turn extracted them from the air; so that we have a kind of physiological "House that Jack built," "This is the Tiger that ate the Cow that devoured the Grass that absorbed the Carbon," etc.

Any considerable difference in the volume of carbonic acid must result in diminution of animal life. Very little above the ordinary standard carbonic acid in air becomes a deadly poison to all warm-blooded animals. If diminished vegetable life would languish, graminivorous animals would die of starvation, and finally the carnivora, being obliged to prey upon each other, would of course become extinct. The result would be a completely barren and desolate planet, perhaps in some degree resembling the moon.

Oxygen is the next in importance as a geological agent. Percolating in rocks, dissolved in rain water, it quickly reacts on all oxidizable substances. Carbonates and protosalts are converted to peroxides; sulphides are changed into sulphates, and sometimes alums are formed.

Carbon and oxygen are thus antagonistic in their action on rocks and minerals, and are thus keeping up a circulation between the earth and the air. The carbon always reduces the oxides, and the oxygen replaces the carbonic acid of carbonates with the same inveteracy.

The ammonia existing in the air is absorbed by plants, and by their decomposition forms nitrates. "And now," Mr. Hardman says in conclusion, "it will be seen what an all-powerful agent the atmosphere we breathe is. Without its aid we should know never a stratified formation, and would simply form a ball of truly primitive rock. We should have no coal, no metalliferous deposits, no rivers or seas, and no rain—consequently no denudation by rain and rivers—for the vapor of waters could not ascend into empty space. We should have—but, last and worst of all, there would be no "we." Life would be impossible, and the earth would finally degenerate into a pale-faced moon." That this is probably her mission cannot be denied; and probably before Saturn and Jupiter have cooled down to a habitable temperature, the senescent earth will roll through space—cold, void, and airless.—*Scientific American.*

SHIPPING LEAD TO CHINA.

The Belgic, which left San Francisco for China and Japan October 23d, as part of her cargo, had 83,852 pounds of lead. If this amount of lead was raw, which it probably was, unless to fill an order, it will hardly prove a better speculation than the large shipments made in the beginning of the year. As we stated over a month ago, China is not a large consumer of lead in any other form than as tea-lead. The Richmond Company at Eureka, Nev., is the largest Pacific coast producer of lead, and to that company, the conversion of a portion of its immense production into tea-lead, the benefit would be vast. Since the freights eastward are enormously high, by going

westward the railroad distance is short; the meanwhile the lead is going in a direct line toward a market which can by care be made to absorb 8,000 to 12,000 tons annually.

We have taken the trouble to visit one of our largest St. Louis sheet-lead manufactories, and as well have ascertained the cost of suitable machinery, aside from the propelling power and buildings of a complete plant for the production of twenty tons of tea-lead every 24 hours: for $2,000 a first class tea-lead mill can be built, having steel rolls eight inches in diameter and three feet long, ground to absolute truth on their faces, with the carrier rollers on friction bearings; the sheets to be finished three on a final pass.

The question has arisen as to the quality and purity of the lead demand for the tea trade. We have handled many tons of tea-lead which we have converted into other forms, where it was assumed that considerable purity was required. No extraordinary quality of fineness is to be found in it. A freedom from zinc is observable. There is, however, in the white-colored tea-lead, small quantities, both of tin and arsenic, neither of which can be hurtful, when the case is kept as free from damp exhalations of water as the preservation of the chest's contents demand.

We have mentioned as favorably situated, for the production of tea-lead, the Richmond Company of Eureka. The enormous production of that company can seriously affect the Eastern market. It is an Anglo-American enterprise, and would not find such violent English competition in the markets of China and Japan as would the North Beach or Eureka Company article. British parties would actually be interested and aid in the establishment of a wide spread demand. Even the tea-producing provinces of India could in time be thus made serviceable markets.

In a future article we will indicate a popular and general use in architecture for lead, wherein its economy and superiority over wood, slate, iron, tin and coopper will be shown. It is now a proper time to devise permanent uses and applications for lead, to prevent the possibility of its ever again glutting the market or falling below five cents a pound. Well directed effort will make both the task and the accomplishment comparatively easy. —*Mines, Metals and Arts.*

THE WONDERFUL FOSSIL BEDS OF OREGON.

A correspondent of the Eugene City (Oregon) *Guard* gives the following account of a visit made last June by himself and another person to the fossil beds of Lake county, that State: Silver Lake and Summer Lake lie on the confines of the desert, by the crossing of which much suffering was experienced by the early Oregon pioneers. Silver Lake is encompassed by "rim-rock," except on the northwest. On the east there is a gap which leads into a basin nearly circular, and which is probably 30 miles in diameter. This basin is surrounded by rim-rock on the south, southwest and west, rising to the height of several hundred feet, with occasional breaks

or canons, sloping into the basin. On the north and northeast of the basin the ascent is more gradual, but at a distance presenting an uninterrupted barrier. The surface of this basin is comparatively level, being subject, however, to slight inequalities in the form of hillocks or low ridges rising but a few feet.

The soil, if we may venture to call it soil, seems to be composed of light sand and volcanic ash, with a percentage of vegetable mould, into which a horse will frequently sink to his fetlocks. Near the center of this basin, and about 18 miles from Silver Lake, in a northeast direction, is "Christmas Lake;" 8 miles from Christmas Lake, in the same direction, and apparently on the same level, are Fossil Lakes. About 5 miles further on, in the same direction, are two springs of tolerably good water. These springs are about half a mile apart. I heard the most northerly called Duncan's Spring, and we called the other Mound Spring. The rocks about Silver Lake and Summer Lake, where stratified, appear to dip to the north.

From 20 to 40 miles in a northwest direction from the Fossil Lakes, set in the lava mountains, or rather mountains of lava. It would seem that these fossil remains might have remained buried from 4 to 10 feet in the earth, and, therefore, unknown to the prying eye of the antiquarian, but for the action of the wind. There seems to be a constant current of wind from the southwest. All that space where the bones are found appears to be scooped out to the depth of several feet, and carried, some of it, to a distance of from 5 to 10 miles, where it is piled up in every conceivable form, evidently by the action of the wind; conclusive evidence of this is found in the numerous little mounds still remaining, and able to resist the action of the wind by the aid of the roots of some more vigorous bunch of sage or greasewood. These mounds present a beautiful example of stratified formation, often 5 or 6 strata, ranging from 3 to 8 inches in thickness, very clearly marked. On the lower levels of this excavation are where the fossils are found. We found fossil bones of the elephant, camel, horse, and elk or reindeer, the horse being much more abundant than either of the others, but all being so clearly marked as to leave no doubt of their identity. There were other bones, apparently of large animals, but your correspondent was unable to name the animal they once belonged to. Among the fossils found the smaller quadrupeds had a representation; bones answering in size to the fox and wolf were found, also others answering to the sheep or goat in size and appearance. Remains of birds were very plentiful, some very large, others quite small. Waders, swimmers, scratchers, and probably climbers, were recognized. The vertebræ or backbones of fish, or some other animal with a backbone like the fish, are found in great plenty; also bones like nothing I ever saw before, therefore, I will not undertake to describe them.

The fossil remains lie scattered over the earth for a distance of 4 or 5 miles in the direction of northeast and southwest, the strip being probably a mile wide. Near the southwest end of the deposit are two small lakes or

ponds, highly impregnated with alkali, the water having a milky appearance, with a disagreeable taste and smell. I have presented to Professor Thomas Condon, of the State University, to whom I was largely indebted for valuable suggestions as to the manner of selecting and packing specimens, the most of my find, retaining but few duplicates myself.

MECHANICS AND ENGINEERING.

LONGEST BRIDGE IN THE WORLD.

The longest railroad bridge in the world was opened for public travel near Dundee, Scotland, on Tuesday, September 25. The structure thus opened spans the estuary of the Tay at a point almost two miles in width. It has been constructed for the purpose of affording facilities for the more convenient conduct of the traffic of the North British Railway Company. Hitherto the North British Railway Company have had to carry their traffic across the Tay by means of a ferry, and this method was not only expensive, but exceedingly slow. Accordingly, their engineer, Mr. Bouch, prepared the plans of the bridge which has now been completed. Parliamentary sanction was obtained in 1870, the bridge being constructed as a separate undertaking, with a capital of $1,750,000.

The contract for the work was obtained in May, 1871, and the foundation stone was laid in the land abutment on the south side on the 22d of July of the same year. The bridge begins about a mile and a half above Newport, on the south side of the river, where the depth of water at high spring tides is 45 feet, the velocity of the current reaching occasionally five knots an hour. To bridge this formidable stretch of water, the engineer planned a bridge of 85 spans, varying in length from 67 feet to 245 feet—those of the largest size, to the number of 13, being placed over the navigable part of the river. In this central section, where it was necessary to provide for the passage of such shipping as frequents the ports of Newburg and Perth, the bridge has a clear height of 88 feet above high water, from which it slopes down to the Fife side with a gradient of 1 in 356, and toward the Dundee side, where it takes a curve to the eastward, in order the more conveniently to join the land line, with a gradient of 1 in 73. Cylinders of iron and brickwork, with a diameter of 9½ feet, built on shore in such lengths as would reach from the rock on which they were intended to rest to a point above low water level, each consisting of a cast-iron shell with a lining of brickwork set in Portland cement, leaving inside a central shaft three and a half feet in diameter, through which the workmen might pass up and down, were connected by means of a wall of brickwork about

five feet wide, thus placing a space of twelve feet between their centers. The whole being then made fast to a system of strong iron girders, barges were introduced at low water underneath the girders so that when the tide rose, the ponderous mass, weighing, it might be, as much as 120 tons, was lifted bodily, and quietly floated out into the river. Having been towed out to the site of the intended pier, the cylinders were lowered by hydraulic apparatus till they rested on the river bottom. Workmen then descended the internal shafts, excavated the material from beneath the cylinders, and so caused them gradually to sink until they reached the rock, in which a level bed was cut for their permanent resting place; but after the work had been in progress for some time it was found that the rock suddenly shelved away to a great depth under beds of clay, gravel and sand. It therefore became impracticable to sink the piers to that foundation, and a new method had to be introduced. The weight of the pier was lightened by substituting in the upper works iron columns for solid brick, while the adoption for each pier of a single oval cylinder measuring 23½ feet by 13½ feet secured a larger bearing than had previously been obtained with two smaller ones. The outer casing was of malleable instead of cast iron. When the large masses were prepared they were floated out and lowered to the river bottom, the sand at the base being removed by a pump invented by one of the assistant engineers. By the working of the pump a large cavity was speedily formed under the cylinder, and the huge mass of metal sunk into it by its own weight, reaching to a depth of about 18 feet below the bed of the river. The interior of the cylinder was afterwards filled to the top with concrete, and the upper part, so far as it stood above the bottom of the river, was next removed, thus leaving an ample platform of artificial rock for the reception of the superstructure, which consisted in the first instance of brickwork in the form of an elongated hexagon, measuring 20 feet by 10 feet, and placed with its greater length in the direction of the current. This part of the pier was likewise put together on shore, and floated out between barges in a length of about 20 feet, being sufficient, when placed upon the cylinder, to reach above low-water mark. From the low-water level the pier was formed of solid brickwork, built in the ordinary way by workmen brought alongside as the state of the tide would permit; and at high-water mark four courses of stone, of an aggregate thickness of four or five feet, finished off this portion of the work. The piers of fourteen spans were founded in this way, the upper works being formed of iron columns of twelve and fifteen inches diameter.

When the piers had been brought to the necessary height, the girders, measuring 245 feet in length and weighing 190 tons for each span, were towed out and deposited. The raising of the girders when the piers had been completed was carried on in lifts of 20 feet at a time by hydraulic apparatus. Two girders, connected by tranverse braces, go to each span, the depths varying according to the width of the space to be crossed. The length of the span diminishes in going toward the shores, on either side of

the navigable channel, the depth of the girders being correspondingly decreased, the minimum being 12 feet. To provide for expansion by heat, which will amount to something like seven feet in the whole length of the bridge, the girders have been adjusted to the piers to allow a certain amount of free play. The bridge has been calculated for a rolling load of one and a half tons to the foot run. Such a burden is more than could be brought upon any span by filling its whole length with loaded freight cars; no part of the bridge would have to undergo a strain of more than four tons to the square inch, and when it is borne in mind that the iron is actually capable of sustaining a strain of twenty-one tons to the square inch, it will be seen that there is an ample margin of surplus strength.

COLORING OF METALS.

Metals may be colored quickly and cheaply by forming on their surface a coating of a thin film of a sulphide. In five minutes brass articles may be coated with any color, varying from gold to copper red, then to carmine, dark red, and from light aniline blue to a blue-white, like sulphide of lead, and at last a reddish white, according to the thickness of the coat, which depends on the length of time the metal remains in the solution used. The colors possess a very good lustre, and if the articles to be colored have been previously thoroughly cleaned by means of acids and alkalies, they adhere so firmly that they may be operated upon by the polishing steel. To prepare the solution, dissolve one half ounce of hyposulphite of soda in one pound of water, and add one half ounce of acetate of lead dissolved in half pound of water. When this clear solution is heated to from 190 deg. to 200 deg. Fah., it decomposes slowly, and precipitates sulphide of lead in brown flakes. If metal be now present, a part of the sulphide of lead is deposited thereon, and, according to the thickness of the deposited sulphide of lead, the above colors are produced. To produce an even coloring, the articles must be evenly heated. Iron treated with this solution takes a steel-blue color; zinc, a brown color; in the case of copper objects, the first gold color does not appear; lead and zinc are entirely indifferent. If, instead of the acetate of lead, an equal weight of sulphuric acid is added to the hyposulphite of soda, and the process carried on as before, the brass is covered with a very beautiful red, which is followed by a green (which is not in the first scale of colors mentioned above) and changes finally to a splendid brown with green and red iris glitter. This last is, according to the *American Art Journal*, a very durable coating, and may find special attention in the manufactures, especially as some of the others are not very permanent. Very beautiful marble designs can be produced by using a lead solution, thickened with gum tragacanth on brass which has been heated to 210 deg. Far., and is afterwards treated by the usual solution of sulphide of lead. The solution may be used several times.—*Van Nostrand's Engineering Magazine.*

SOLUBLE GLASS.

The silicates of soda and potash differ from the other silicates grouped under the general name of glass in being soluble in water; hence they are known as soluble glass, water-glass, liquid quartz, etc. While ordinary glass has been known from very ancient times, these peculair compounds are quite new to us, having been accidentally discovered by the late Prof. Fuchs of Munich, in the year 1818, while experimenting with a view to the preparation of pure silica. In 1823, when the Munich theatre was rebuilding after its destruction by fire, the Bavarian government appointed a scientific commission to consider by what means the woodwork and stage fixtures might be rendered incombustible; and Fuchs, in connection with Pettenkofer, after careful investigation, settled upon soluble glass as the best agent for the purpose. It has since been much used in this way, though for textile fabrics the tungstate of soda has come to be preferred. In applying soluble glass it is necessary to begin with a weak solution, and to let the first coat dry thoroughly before putting on a second, which may be more concentrated. A wash of lime is sometimes used between the two coats.

When the soluble glass is applied to surfaces of plaster and limestone, an interesting chemical reaction takes place, resulting in the formation of silicate of lime. A vitreous surface is thus produced, impervious to moisture and unaffected by atmospheric agents. Soluble glass is also used as a vehicle for mineral colors in a kind of fresco-painting, known as *stereochromy*, which is intended to withstand exposure to the weather. The famous frescoes by Kaulbach in the Museum of Berlin were done in this way. It is also coming to be employed for preparing paints for ordinary use, and there are factories exclusively devoted to the manufacture of this class of pigments.

One method of making artificial stone is by moistening fine sand with a solution of silicate of soda, pressing the mixture into mould, drying it and exposing it to a high temperature. The silicate fuses and cements the grains together into a mass resembling sandstone. Any desired color may be imparted to the stone by the admixture of metallic oxides previous to the moulding process. Thousands of tons of the silicate are consumed for this purpose in England.

Another important application of soluble glass is in calico-printing, where it is now extensively used as a mordant. It is even more in demand in soap-making, for which it has advantages over resin, on account of its alkaline character. It also enters into the composition of fire-proof cements for stoves and other iron-work, and especially for putting up iron fronts for buildings.

In this brief notice we have mentioned only the leading uses of this valuable substance. The demand for it in the arts is daily increasing, and it is probable that its commercial and industrial applications are destined to be immensely extended in the future.—*Boston Journal of Chemistry.*

XUM

HOUSEHOLD ECONOMY.

ANCIENT COOKERY.

Very often is a history locked up in a word. It is certain that the words in which our ancestors expressed their thoughts come down to us and help to influence our thoughts. The structure of our language has been greatly influenced by the ancient languages, and the Greek and Roman classics are considered so important that they are made text books in our schools. Is it not possible that our cookery may also have the same stamp, and that as unconsciously as we press into service the classic thought and the classic word, we may also follow the classic taste in classic recipe? As our words have come down to us in mother tongue from generation to generation, as the son speaks like his sire, so the daughter cooks like her mother, using styles and condiments, dishes and recipes, that her mother used before her.

Where did they originate? So far as our observation goes, women are not given to devising new dishes. It is true that changes come, perhaps through accident, perhaps through stress of circumstances, but often with as little thought as might be given to the gradual change of a word. But if classical literature has had an important influence on our modes of thought, is it not much more probable that classical cookery may have had quite as important an influence on our modes of living, and through them upon our health?

We have reason to believe that primeval cookery was exceedingly simple. Our first glimpse of it is in the patriarchial tent of Abraham, where Sarah kneaded "fine meal" and made cakes upon the hearth, which were served with the dressed calf and butter and milk. For aught we can see in the text, the patriarch himself cooked the calf, and if he did so, he was justified by noble company. His own grandson is represented as making a pottage so seductive as to beguile his brother of the birthright The heroes of Homer did their own cooking. Achilles turned the spit. Their exact methods of cooking are not very carefully recorded, and it is probable that the women did the most of the culinary work, yet the mention of many such circumstances seems to indicate that it was done with very little art and upon occasion by those who needed it. Roasting meat before the fire or seething it in a pot, and baking cakes in the hot ashes on the hearth were probably for ages the highest achievements in that line—wholesome cookery indeed! Shall we say that it were better if we had never departed therefrom? Is it true that man in this respect, in his best estate, is a barbarian, or shall we take the results of a long experience in waywardness and learn how to come back to nature intelligently and permanently?

The first gross violation of nature we find in the leaven which apparently

the Hebrews learned to use among the Egyptians. This was simply sour dough, usually kept by reserving a piece of the bread-dough until the next baking. This addition excited fermentation in the mass more readily than if left to sour of its own accord. With the increasing fineness of their flour had come the need of something to make it light, and as they had not our ovens or gem-pans or our other intelligent devices for making bread at once light and wholesome, they accepted this chance device of leaven and used it for centuries; indeed, it is still in use. There is little doubt that its impure character was partially recognized among the Hebrews, for in some of their ceremonial purifyings all leaven and all fermented articles were removed from the house.

The first traces we find of yeast are in the writings of Pliny. He says that for leaven the Roman mixed millet with sweet wine and let it ferment a year! They also employed wheat bran soaked for three days in sweet white wine and dried in the sun. Of this they diluted a certain quantity at the time of making bread, which was left to ferment in the best wheat flour and afterward mixed with the entire mass. This is our present style of "sponging," plainly enough, though the "yeast" is not so definite. Indeed, these and the following items show that the Romans at that time did not use yeast in its present form: "A dish containing two pounds of barley paste was heated until ebullition commenced. It was then put into vessels until it became sour. Very often leaven was procured from dough just made. A piece was taken from the mass and left to turn sour for subsequent use." In addition to all this, Pliny goes on to say that the Gauls and the Spaniards, after having made a drink from grain, *saved the scum* to raise dough, and that their bread was the lightest of all. Perhaps some of our readers will recognize this as having the same origin as our "brewer's yeast;" to others, who never before looked so far, it will unfold the not over-clear origin of the first cup of yeast—the filthy scum of the decaying liquid in the brewer's vat. Verily, they did find something at last wherewith to make their bread light, but it was at a rather severe cost to its cleanliness and nutrition.

In the gratification of the palate and the fancy, the Greeks and Romans at last launched upon a mad whirl of artificiality, which delighted in outraging all laws of nature, moderation, common sense, and even decency. One hardly knows where to begin the strange list, unless, indeed, we begin with the degeneracy of aims, the grossness of greediness, and the recklessness of expense which permitted such extravagances.

Expensive eating came to be apparently the only ambition of the Roman people and their rulers. Their senators vied with each other in giving the most extravagant dinners, and their emperors took the lead to such a degree that some of them are noted only for the extent of their appetites. The Emperor Claudius sat down to table at all hours and in any place; nor did he leave the repast until distended with food and soaked with drink, and then only to sleep. When he awoke, a tickling feather relieved him of his surfeit, and he was ready to eat again.

XUM

Many of the gourmands became great adepts in the use of the feather. Vitellius used it so effectually that he could cause himself to be invited to dinner by several different senators the same day. Little he cared if it should cause their ruin; for they could not venture on such a banquet at a less expense than 400,000 sesterces ($16,000), and this was but a moderate sum. Lucullus served Cicero and Pompey with a little collation that cost $5,000, and there were three of them to eat it. How they could expend so much may be easily seen if we examine their dishes, which were little prized unless procured at great expense. They had flesh of peacocks at $40 per pair, was preferred to that of cheaper but more delicious poultry. But since many could avail themselves of peacocks, even at this price, those who would not be outdone had dishes of peacocks' brains. Another dish was composed of the tongues of singing birds. Young pigs were fed on dates; geese were fattened on figs, and their livers alone were used, being soaked in milk and honey—the forerunner of the modern *paté de foie gras.* Fish were in great demand, and those which were brought the greatest distance were the most highly esteemed. Whole fleets of ships were employed in bringing these and other dainties from abroad. Roman nobles would not unfrequently pay one hundred dollars for a single lamprey. Mullets sold as high as from seventy-five to one hundred dollars each, and it is related that Crispinus paid three hundred dollars for one weighing six pounds, and considered it cheap at that. In the reign of Tiberius three of these were sold for one thousand dollars. What, then, must be the cost of dishes composed only of the livers of these fish? Heliogabalus had upon occasion two large dishes filled with their gills only. At last the wealthy built expensive reservoirs and kept their own fish, though not with a view to economy, for they fed them with the rarest dainties. It was even said that slaves were thrown in to satiate these pets, but whether this be true or not, their sea-eels were commonly fed with veal soaked in blood. Other sorts were taken from the river just where it received the filth from the entire city.

In wonder it may well be asked what had become of the common sense and decency of human nature. We can account for these excesses and atrocities only by observing the entire departure of the people from natural rules and their utter abandonment to the artificial. Instead of studying into the nature of their materials, with a view to producing the greatest harmony in their combinations, they seem to consider it a crowning achievement if they could entirely obliterate all traces of their real nature and substitute therefor whatever was most foreign and not recognizable. Fish of various sizes were served up to resemble pork, veal, beef, or mutton, and *vice versa.* Vegetables were cooked to resemble meats, and meats disguised to resemble other substances. Eggs were served, which on being broken were found to contain fat ortolans. The cook of Louis XIV, who on Good Friday served up a dinner composed of poultry and butchers' meat, but which was really nothing but vegetables, had a good deal of the same spirit, and must have had no small amount of practice to bring about such results.

But what of the effect upon the taste? It is related of one of these old gourmands that he was seized with an invincible desire for loaches. It was in the middle of the night and they were far from the sea. He had no idea where the loaches could be obtained, but loaches he must have, and his chief cook was summoned. "Loaches, sire!" cried the man in dismay; but the command was imperious and must be obeyed. The cook was more skilfull than the noted Vatel, cook to the Prince of Caudè, who when he found that his master was to entertain the king at dinner, and there were no fish to be had, went to his room and threw himself upon his sword. The demand for loaches sent this man to his room, not to kill himself, but to study and experiment. Before long he came forth with a plate of fried loaches, irreproachable in appearance, and as to taste the gourmand declared he had never before eaten any he liked so well! And of what were they made? Of radishes, pared, cooked and seasoned. But if we admire the skill that could prepare such a dish, what must we think of the taste that judged it?

Of this taste we may judge partly by their seasonings. The following ingredients composed their sauce for crawfish: honey, vinegar, wine, garum, oil, chopped onions, pepper, alisander, carrots, cummin, dates and mustard. The following is stuffing for a crab: cummin, mint, rue, alisander, pine nuts and pepper soaked for a long time in garum, honey, vinegar and wine. The following made sauce for roebuck: pepper, parsley seed, dry onion, green rue, spikenard, honey, vinegar, garum, dates, wine and oil. The following is the entire recipe for a dish of ducks' brains: "Cook some ducks' brains and mince them very small; then place them in a saucepan with pepper, benzoin-root, garum, sweet wine and oil; add milk and eggs, and submit the whole to the action of a slow fire." The celebrated Apicius gives this dressing for roast duck: "Make a mixture of pepper, cummin, alisander, mint, stoned raisins or Damascus plums; add a little honey or myrtle wine; place it in a saucepan, cook, and then add to these substances vinegar, garum, and oil; afterward, some parsley and savory.

We find a large share of the recipes equally absurd; we select a few cakes from Apicius: "Mix pine nuts, pepper, honey, rue and cooked wine; cover with eggs well beaten; submit this mixture to a slow fire, and serve after having smeared it with honey." Again: "Make a compact mixture of honey, milk and eggs; let it cook very slowly, and serve after having sprinkled it over with pepper." Less elaborate cakes were made with cheese and rye or other kinds of flour, and sometimes with the addition of eggs and honey. Sugar they did not have, hence dates, figs and honey were their principal sweeteners, but cheese was a common ingredient of their cakes. Here is one of the most simple: "Half a pound of flour, two and a half of cheese, three ounces of honey and one egg. As soon as baked it was smeared with honey and dredged with poppy seed." It was eaten with spoons. We should hardly accept it now, either for taste or wholesomeness, though it is not quite so gross a conglomeration as the sauces already given.

It will be noticed that every one of these included garum. This was the "universal" sauce of meat cookery. Like the East Indian curry, it went into everything. We have no such universal seasoner, unless it be salt. Catsup and Worcestershire sauce, as used by some individuals, afford some illustration, only that these find their place in the caster, while the garum was usually added by the cook. In a collection of old Roman recipes now before me, of fifteen for preparing chicken, lamb and kid, twelve contain garum. Its character betrays at once the coarseness of the Roman taste and the uncleanness and artificiality of Roman food preparations. Its essential ingredients were salt and decayed fish. They "macerated the intestines of fish in water saturated with salt until putrefaction began to show itself, and then they added parsley and vinegar." "A thick garum was also frequently obtained by allowing the entrails and other parts generally thrown away to liquefy in salt." "In the time of Pliny mackerel was preferred, of which they employed either the gills or the intestines."

So if any one wishes to get a tolerable idea of the character of this famous Roman sauce, let him visit an ancient and deserted barrel of salt mackerel, in which some of the fish have been left to spoil, and secure some of the delectable brine. He will probably find it sufficiently revolting to his unaccustomed taste, without attempting to manufacture it *en regle* from the gills and intestines. That the above are not exceptionally repulsive methods of preparation will appear from further recipes. The following was in very common use: "Amatuus took very small fishes or only their entrails and threw them into a vessel with a large quantity of salt. These were exposed to the sun and long and frequently stirred. When heat had caused fermentation and the vessel contained only a kind of pulp or paste, almost liquid, a kind of willow basket was introduced, into which the garum alone could penetrate." "Although fish was generally used, the flesh of several animals was sometimes employed in the formation of garum."

Of course, this was too inexpensive to suit the taste for lavish display, and the "apogee of refinement" was secured by using the liver of the red mullet, the expensive fish we quoted above. Others again used the blood of mackerel or of the mullet, and a quart of this garum, on account of its scarcity and the care necessary for its production, cost from $15 to $20. Oeno-garum was a preparation of garum with wine and spices, and oleo-garum with oil and spices; hydro-garum, with water, etc.

"The principal elements of garum, then, were almost invariably the same —fish, salt, and a greater or less fermentation. No doubt this was detestable, but then no one ever thought of regaling himself with this liquid. It was never taken alone, but was reserved as a seasoning for a host of dishes in order to heighten their flavor." Apicius, that greatest of authorities among Roman cooks, "places it in almost every sauce, but never serves it by itself, nor does he use it unmixed." It was so strong and foul that it could not be eaten by itself, but to offset that they befouled all other dishes with it.

Garum itself has dropped out of our legacies from this ancient cookery, and from those impure times; but not so all the principles that lay at the foundation of its use. We find them still in the fermentation, the indigestibility, and the artificiality of many of our food preparations. By fermentation we have prepared a great many poisonous drinks; we have destroyed much nutrition in bread and bread preparations; spoiled many good fruits and vegetables by making them indigestible, as pickles and sweet pickles, and brandied fruits; but above all, we have inherited so artificial a style of cooking that our cooks study the rules, the recipes, and the cook-books, and never the nature of the materials, only so far as to ascertain their plasticity with regard to shape. This tendency to artificiality is one of the greatest misfortunes now in our cookery. It so dominates us that we have very little thought of originality. Women who can invent fashions, trim up or make their own bonnets out of old materials, and make over dresses to look good as new, scarcely ever get up a new dish for their tables. If they do chance to vary an old style, under the force of circumstances, and get a good result, they seldom follow it up and perfect it until they make a new and permanent dish. And this is largely because they do not understand the principles of cookery or the harmonies of combination. These harmonies are not recognized. They have scarcely seen the light since they were pared into the grotesque shapes that disgraced the Roman tables and drenched into uniformity of taste with garum and kindred devices.

A lady who has had long experience of "skilled" English cooks, remarked to me that their dishes were usually attractive in appearance, but disappointing to the taste. The French women are more apt in their study of materials, and more enterprising in their combinations; but we have only to look into books like that of Blot to see "two bay-leaves and a sprig of thyme," repeated with a frequency that inevitably brings to mind the garum of Apicius. If any thoughtful mind could fail to see the probability of perpetuating error in the unquestioning uniformity with which the daughte follows the mother in her cookery, we might trace the descent of still other preparations that have come down to us like the fattened geese livers, the yeast, and other products of fermentation; but we hope enough has been said to awake a questioning spirit which shall refuse to take any recipe or custom merely because it has the sanction of age. Any abomination sanctioned by age is doubly an abomination, and requires greater energy of effort to contest its demands. We do not wish our government or people to copy the excesses of the Roman people, and certainly in their later days their excesses had everything to do with their artificial and luxurious cookery. The bare possibility that in our traditional recipes we may be drinking from a fountain so defiled as the Roman cookery, should lead us to seek for fresher springs and for natural fountains. And if we can learn from all this waywardness some reasons for naturalness and its advantages, it will not be in vain that we have studied for a little while the artificiality of a dominant phase of ancient cookery.—*Julia Coleman in Phrenological Journal.*

WHY MILK SOURS DURING THUNDERSTORMS.

BY MALVERN W. ILES, PH. D.

There have been various surmises in regard to this subject; none, so far as we have been able to learn, have been substantiated by experiments.

In order to see if milk did really sour during heavy thunderstorms, I made several observations which proved to me that this was not an erroneous opinion which is so commonly held by the dairymen. My experiments to arrive at the cause of the phenomena thus observed may be stated as follows:

I took skimmed morning's milk, filled a eudiometer tube (300 c. c.), then introduced 100 c. c. pure oxygen gas.

Then by the use of an ordinary battery, and a small Ruhmkoff coil, caused sparks of electricity to pass through the oxygen for five minutes. The current was then broken, the tubes shaken up and allowed to stand for five minutes. The milk does not appear quite as opaque, and shows a noticeable acid reaction.

On continuing the current for five minutes longer, making in all 10 minutes, the milk curdles very perceptibly, and shows a decided acid reaction.

The contents of the tube on standing for twenty minutes had reached the consistency of ordinary sour milk or bonny-clabber.

From the above experiments it will be seen that the oxygen was converted into ozone, which we think may be stated as the cause for the rapid souring of milk during thunderstorms.

The increased acidity is due to the formation of lactic acid, and most probably some acetic acid, by means of the ozone. One or both these acids, then, causes the casein to be precipitated.—*Scientific American.*

A SIMPLE METHOD OF VENTILATING ROOMS.

Dr. H. N. Dodge informs us that he has found the following plan very satisfactory for the ventilation of rooms that are much used during cold weather: Nail or screw a neat strip of wood, from one to two inches high, upon the window sill, just inside of the sash and extending entirely across from one side of the window frame to the other. Upon the top of this strip fasten a piece of ordinary "weather strip" so that there will be formed an air-tight joint between the "weather strip" and the lower sash of the window, whether the latter is shut down tight or raised an inch or two, the lower cross-piece of the sash sliding on the rubber of the "weather strip" as the sash rises. With this simple fixture in place the lower sash may be raised enough to admit a stream of air between the lower and upper sashes, where they lap over each other at the middle of the window, without ad-

mitting the least air at the window sill. The air admitted between the sashes is thrown directly up toward the ceiling, and there mixes with the heated air at the upper part of the room. The room is thereby ventilated in a thorough and agreeable manner without drafts of cold air upon the persons in the room. The fixture should be applied to several windows in a room. The amount of ventilation may be regulated by the distance that the lower sash is raised. This arrangement is cheap, simple, and effective. —*Scientific American.*

PRODUCTION OF CRYSTALLINE FIGURES UPON GLASS OR PAPER.—Window-panes, wall-paper, or other surfaces may be handsomely decorated by means of the following simple process: Prepare as concentrated a solution as possible of any easily crystallizable salt, as magnesium sulphate, zinc sulphate, etc., and dissolve in it a small quantity of dextrin. Filter the solution through white filtering paper, and apply it evenly and thinly, by means of a broad brush, to the glass or other surface, which is then kept in a horizontal position for about fifteen minutes. During this time most magnificent groupings of crystals make their appearance, resembling the ice-flowers of winter, which adhere firmly to the surface, but may be permanently fixed by means of a thin coating of shellac. If it is desired to remove part of the coating, as, for instance, to examine the crystals for their optical behavior towards polarized light, it is only necessary to pour a thin layer of collodion over them, and, after drying, to strip the latter carefully off. In this way the whole crystal-group may be lifted off the glass, adhering to the collodion film.—*New Remedies.*

WASHING FLANNELS.—A lady correspondent says: "I will give a little of my experience in washing flannels. I was taught to wash flannel in hot water, but it is a great mistake. In Italy my flannels were a wonder to me; they always came home from the wash so soft and white. I learned that the Italian women washed them in cold water. Many a time have I watched them kneeling in a box, which had one end taken out, to keep them out of the mud, by the bank of a stream, washing in the running water and drying on the bank or gravel, without boiling; and I never had washing done better, and flannels never half so well. I have tried it since, and find the secret of nice soft flannels to be the washing of them in cold or luke-warm water, and plenty of stretching before hanging out. Many receipts say, Don't rub soap on flannels; but you can rub soap on to the advantage of the flannels, if you will rinse it out afterward and use no hot water about them, not forgetting to stretch the threads in both directions before drying. Flannels so cared for will never become stiff, shrunken, or yellow.—*Boston Journal of Chemistry.*

TO REMOVE SILVER STAINS FROM WOVEN FABRICS.—The following process is said to be especially successful in removing spots from materials which

have been several times washed: First prepare a saturated solution of chloride of copper; dip the spotted piece in the solution, and allow it to remain some minutes, or according to the character of the stains. Then rub the stains with a crystal of hyposulphite of soda. When neutral chloride copper is used, the color of the stuff does not change. This process can be repeated.

To Wash Red Table Linen.—Use tepid water, with a little powdered borax, which serves to set the color; wash the linen separately and quickly, using very little soap; rinse in tepid water, containing a little boiled starch; hang to dry in the shade, and iron when almost dry.

SCIENTIFIC MISCELLANY.

CLEOPATRA'S NEEDLE.

Waterloo Place was the site always thought of from 1820, the date of Mehemet Ali's gift of the obelisk to George IV, soon after which the nation was led to look for its erection on that spot, "for ages to serve to revive the recollection of the exploits of our naval and military heroes." Sir Robert Peel at that time told Lord Westmeath he thought it was a monument which ought to be brought to London and erected as a memorial to Sir Ralph Abercromby and others, who had fought and died in Egypt. But the question slept for thirty years, until, on the 2d of June, 1851, Lord Westmeath cited these authoritative opinions in putting his question to the Earl of Carlisle in the House of Lords as to the means which had been taken for appropriating and removing the obelisk to this country. On this occasion Lord Westmeath tried in vain to overthrow by counter testimony the damaging report of the late Sir Gardiner Wilkinson—that the inscriptions were in so bad a state that the obelisk was not worth removing. Mr. Hume, also, on the following July 1, was fain to withdraw his motion in the Commons for the removal of the obelisk, which was thought not worth the cost, although he offered to bring it to this country for £7,000. Happily, Sir Gardiner Wilkinson turns out, in this instance at least, to have been far from infallible. Prof. Wilson, while frankly owning the weather-beaten look of the monolith after the 3500 years through which he holds it to have battled with time, describes cheerily enough the rugged rose granite's tight grip of the written record intrusted to its keeping: "In places it will be seen that the angles are rounded; here and there the once burnished surface is blurred and rough, and some of the engraving had suffered almost to obliteration: nevertheless, as a whole, it is remarkably perfect. It is

said to be in better preservation than the standing Needle at Alexandria; it has happily escaped serious injury from its fall; and its entombment in the sands of the seashore and the rubbish of building material would seem to have been favorable to its preservation. The sides most injured are those to landward, and the agents of mischief the sharp pellets which ride in the sand storms so common in Egypt, that drive their sharp and piercing atoms against an opposing surface with the fury of musket shot."

It is worth notice, in passing, that the present is just the 1900th year since the Augustan ceremonial. Of course, when that happened Cleopatra had been dead seven or eight years. But against the suggestion that she had, therefore, no right to give her name to the Needles, it is plausibly urged that she might have designed their removal from Heliopolis, the Biblical On, where the inscriptions on them say they originally stood, as she may have designed the temple of Cæsar itself. Prof. Wilson dwells on the interesting associations of our monolith with On and with the Land of Goshen, in which the metropolis of Egyptian learning stood, and so with the history of the Hebrew patriarchs and people, with their great leader, Moses. Moreover, under the shadow of its now lone obelisk, the oldest in the world, tradition locates the Holy Family. "Originally there were three pairs of obelisks at On, but of these only one single obelisk remains, almost the sole surviving relic of that ancient city." Prof. Wilson thinks it was erected nearly 5000 years ago. The other four obelisks were all set up by Thothmes III. and his family. "Two of these four were called Pharaoh's Needles, and now serve to decorate the cities of Constantinople and Rome, while the remaining two were transferred to Alexandria to become celebrated as Cleopatra's Needles." It is plain "Our Egyptian Obelisk" need not be ashamed of its lineage. Nowhere in the land of obelisks, not even at sacred Thebes, did there ever stand a finer or more interesting group of these monoliths, all symbols of the Sun-god's rays, than the three pairs which guarded the pylons of his temple in his own city, On. Of the six, but one has disappeared. Its surviving sister, the noble shaft of Usertasen I, who heads the grandly historical Twelfth Dynasty, still keeps lonely watch on the spot. Of the other four, all bearing the name of the greatest conqueror of the new empire down to Alexander, not excepting Ramses-Sesostris, two are divided between old and new Rome, the third marks the site of the old part of Alexander's Egyptian capital, and we are now craning our necks in expectation of the arrival of its fellow in the greatest city of the modern world.—*London Times.*

RAISING ROSES FROM SEED.—To raise roses from seed, take the seed when fully ripe, separate them from the pulp, mix them with moist sand, put them in a little box or flower-pot, and then place them in the cellar, taking care that they are kept moist all winter. In the spring sow sand and all in a common hot-bed, and when the plants are about an inch high transplant them into light, rich soil, shading them till well rooted.

PROCEEDINGS OF THE ST. LOUIS ACADEMY OF SCIENCE.

A regular meeting of the St. Louis Academy of Science was held Nov. 5th, at the Polytechnic Building. The chair was taken by Prof. Riley. There were also present, Dr. Engelmann, Judge Holmes, W. T. Harris, Dr. Alleyne, Dr. Forbes, M. L. Gray, F. W. Raeder, Willis N. Graves, Judge Albert Todd, O. W. Collett, and F. E. Nipher, Secretary.

After routine business had been disposed of, Judge Holmes made some very interesting comments upon a paper treating of the origin of the human species in America. The theory advanced was the probability of the existence in the miocene period of a land connection between Scotland and Greenland, over which emigration took place from the Old to the New World. It was also probable that, in the post pliocene period, Southeastern Asia, New Holland and America were also connected by land, the bed of the ocean in both of the parts where the land connection once existed being now but 500 fathoms below the surface of the water. The speaker, whose comments were received with deep interest, closed with the remark that the theories advanced should not be rejected simply on the ground that they seemed improbable.

The Chair remarked that scientists had begun to learn that it was unsafe to reject new theories on scientific subjects, simply because of their improbability, and hence the Society should not disregard altogether a communication submitted to it by a person who had devoted his time to the invention of a flying machine. The Chair did not himself believe that any apparatus would ever be perfected by which a man would be enabled to so apply his own muscular power as to enable him to fly, though at the same time he had faith that by properly applying the principle of the screw a machine would, perhaps, within the next ten years be invented which would travel through the air.

Dr. Holmes announced that he had prepared a paper, with illustrations, upon the *agave shaevi*, a flower from the Pacific coast, which had excited much interest among St. Louis horticulturists. The paper was referred to the Publication Committee.

Dr. C. V. Riley then read a paper on the larvæ habits of the blister beetle, an insect of great commercial value, some of which were quite common in the United States and were in their developed state frequently very injurious to vegetation. It had been supposed that these larvæ, as a rule, lived in the earth and fed upon the roots of plants. Late investigations, however, had shown that the larvæ of the European blister beetle are parasites, living in the cells of the honey bee and feeding upon the eggs therein. They differ from other larvæ in having seven instead of four stages of existence. The paper contained an interesting description of the life of the larva of the European beetle from the first stage in which it formed its home in the hive by attaching itself to the bee by means of a sticky fluid

which exudes from its spinneret, through its other stages and up to the time of its full development. In America the blister beetle was the parasite of the locust. The female blister beetle selected warm sunny spots of earth in which to lay her eggs, her instincts inducing her to choose a place for oviposition where the locusts also deposited their ova. Immediately upon receiving life the larva secures a locust egg, the contents of which it sucks up. In cases where two larvæ happen to strike upon the same egg a fight invariably ensues whose only termination was the death of one or both combatants. From the reader's investigations he was able to say that in all probability from St. Louis southwards there were two generations of larvæ every year. The paper, which will be published with illustrations, will be a very valuable addition to American entomological discovery.

On motion, the paper just read, and one or two others, whose titles he announced, were referred to the Publication Committee.

In answer to a question, Prof. Riley stated that, while there were no blister beetles in America exactly similar to those of Southern Europe, yet it had been shown that the American insect was as valuable, commercially, as its transatlantic congener.

Dr. Englemann stated that, as a result of his meteorological observations, he was able to announce that the first frost of the year would occur last night. There had been white frosts in various parts of the State, but during the night there would be a black frost, which would kill plants—a thing which had not yet happened this year. This was later, on an average, than usual. He prophesied that this morning the castor-oil plants, which were blooming during yesterday, would be killed by the frost today.—*Globe-Democrat.*

FOSSILIZATION OF FLESH.

Prof. Mudge responds to the criticism of "M. D." in the Kansas City *Times*, as follows:

NEWTON CENTER, MASS., Nov. 21, 1877.

Your paper, containing a criticism on my article in the WESTERN REVIEW in relation to the fossilization of flesh, has just reached me here. If the gentleman will take the trouble to study the question as much as I have done he will find that I am correct; and that no fossil flesh is known in science. The cases cited from Pompeii are well known. They are casts of the human form, not fossilization of the human flesh. The moist ashes covered the bodies, the fleshy portions decayed, leaving a cavity containing nothing but bones. The layer of ashes became so firm that artificial casts were made of the cavity, from which the photographs were made.

From personal acquaintance with the museum at Yale College, I can say that Mr. Boyer, cited by M. D., is mistaken, and that no fossil flesh is contained in that collection. The nearest approach is the membrane (skin)

wing of a small Pterodactyl, the only specimen known, which cost Prof. Marsh $1,000 in Europe.

The petrifactions of the shells of oysters in Colorado I have seen by the cartloads, but the soft eatable portions are never fossilized. The case cited from Monrovia, (not "Munervia,") Kansas, I recollect, and similar cases are frequently reported in newspapers, but whenever a scientific person has had the opportunity to examine the bodies, the flesh has never been found fossilized.

M. D.'s quotations from Chamber's Encyclopedia are in harmony with my statements. "Organic remains" include wood, shells and bones. The "animal remains" of the oyster in the shell is carbonate of lime. In bones it is phosphate of lime, and "the original cell structure, however minute and delicate, remains, and is still seen under the microscope." "Erenberg found 42,000,000,000 (forty-two trillions) of fossil infusoria in one cubic inch of tripoli, each perfect in structure." In the latter case the animal basis was silica, the soft fleshy portions of the body were not fossilized. The Struthious birds of New Zealand I have frequently examined. There is no flesh on the bones, but then phosphate of lime remains nearly as when living.

This statement, that flesh is never petrified may strike M. D. "as being absurd, if not utterly ridiculous," but he will find it correct. Now if he will only produce flesh petrified or fossilized, he will not only render a great favor to science, but he can also enrich himself by selling it at a high price.

In the course of Professor Rood's researches respecting colors, of which some account was recently given in the report of the proceedings of the National Academy of Sciences, he obtained a numerical value for the luminosity of different tints. The results are as follows: White paper being estimated as having a luminosity of 100, vermillion has 23.8, blue-green 26.56, chrome yellow 80.3, cobalt-blue 35.38, green 41.19, purple 14.83. The vermillion was spread over the paper in a thick paste. The blue-green consisted of a mixture of emerald-green and cobalt-blue, applied in a thick paste. The chrome yellow was of the pale kind, and was applied in a series of washes, after the manner of water-color painting. The cobalt-blue was applied in the same way as the chrome-yellow. The green was a mixture of emerald-green and chrome-yellow, applied as a thick paste. The purple was an aniline color.

From statements made at a meeting of the California Academy of Science, the eucalyptus tree may be enumerated among the means for checking fire. Eucalyptus shingles are said to be fire-proof. A tree of this species was exposed to the San Francisco fire of 1876, and is still flourishing. The notion is urged that the spread of fires in cities could be checked by setting out such trees for shade and ornament. All varieties of the eucalyptus are said to possess this valuable property.

EXPERIMENTS WITH AMMONIA AND FLOWERS.—A French journal states that Professor Gobba has lately made a series of experiments for the purpose of determining the changes which ammonia produces in the colors of different flowers. For this purpose he merely makes use of a dish in which is poured a small quantity of common aqua ammonia. Over this he places a funnel, in the tube of which are inserted the flowers to be experimented upon. In this way he has shown that blue, violet, and purple flowers change to a beautiful green; deep red carmine flowers to black, white to yellow, etc. These changes are most striking when the flowers have several different tints, in which the red lines are turned green, the white yellow, etc. An interesting example is that of the fuchsias, with white and red flowers, which in consequence of the ammonia vapor become yellow, blue, and green. If, when these changes have taken place, the flowers are immersed in pure water, they preserve their new colors for several hours, after which they gradually resume their original tints. Another observation due to Dr. Gobba is that the flowers of the asters, which are naturally inodorous, acquire a very agreeable perfume under the influence of ammonia. The flowers of the violet asters also become red when they are moistened with a diluted solution of nitric acid. Again, these same flowers, if exposed in an open box to the vapor of hydrochloric acid, become after some hours of a beautiful carmine red, which they preserve, after being dried in the dark, if kept in a dry, dark place. Our readers may like to try some of these experiments.—*Boston Journal of Chemistry.*

A DEEP WELL.—English geologists have watched with great interest the progress of a well which has been bored for the benefit of a London brewery, and which has just been successfully finished. At 150 feet the clays and gravels were passed, and the upper chalk began, from 490 to 812 feet the work lay through hard lower chalk and marl; at 840 feet, gault; at 1,004 feet the solid green-sand was reached below which water is always found. The work was done with a diamond drill. One crown of diamonds has cut 400 feet; but the strata have proved of very varied hardness, and the flints in the chalk have occasionally delayed the speed of the work. When there are no mishaps the progress is 14 or 15 feet a day. The value of the diamond crown of the boring tool is about $500.

THE city of Providence, R. I., is excited concerning its waterworks. A Cornish steam engine in use, which is estimated to have cost $580,000, is said to be cracked and disabled. As a preliminary to giving the public an education in respect to waterworks and engineering, so that intelligent measures shall hereafter be adopted, the Providence *Evening Press* has issued an illustrated "extra," containing a descriptive history of the invention of the Cornish steam engine, beginning with the attempts of a century ago. The "extra" is illustrated. Probably the moral to be enforced is to buy somebody's pump.

THE mode of development of deers' antlers formed the subject of a valuable essay, delivered by Professor Theodore Gill, before the National Academy of Sciences at its recent meeting. The following were the chief conclusions reached: Antlers are horn-like appendages of frontal processes, peculiar to the deer, developed periodically and concomitantly with the sexual organs, chiefly in the males, either as simple spikes or with a tendency to bifurcation, especially (but not exclusively) in the direction of greatest or axial growth. The modification of the antlers and their contour in the various forms of the family, are chiefly dependent on and determined by the diverse exhibitions of this tendency, and examples of several kinds are furnished by the general Cervus, Cariacus, (also Rusa, Pudua,) and Elaphurus. As is generally known, in all the deer the antlers of the first year, at least, are simple spikes. In Pudua, the antlers remain simple and never bifurcate. In Cervus, the direction of growth is continuously upward and backward, and dichotomization takes place from the hindmost prong of the preceding year, the antlers being differentiated, however, into posterior "beams" and anterior "brow-antlers." In Cariacus, the direction of greatest growth is deflected and the main axis continues sub-spirally forward into the homologues of the anterior upper prongs of the fourth year. Rusa exhibits a similar tendency. In Elaphurus, the direction of principal growth is upward from the base and forward, and the antlers are differentiated into two elements, (1) the anterior being homologous with the brow antlers of Cervus and functionally usurping the place of the main ones, and (2) the posterior being correspondingly reduced and thrown backward.—*N. Y. Tribune.*

THE postponement of the Woodruff Scientific Expedition till next May seems to have been resolved upon rather suddenly. Within a few days previous to the announcement of the change of plan, the expectation of departure during the present month was encouraged.

BRAZILIAN METEORIC IRON.—A meteorite from Brazil has been analysed, and found to contain 64 per cent. of iron, and 36 per cent. of nickel, corresponding thus nearly to the formula Fe_2Ni. It is remarkable for its richness in the latter metal.—*Boston Journal of Chemistry.*

CANAJOHARIE, in this State, boasts the possession of a stone relic, recently found below the surface in making an excavation. Its size, strange to say, is not given in the newspaper accounts. The stone is believed to be very ancient, and is carved in a shape that is said to bear close resemblance to the Egyptian Sphynx. Perhaps, too, it may present a perpetual riddle.

ASTRONOMY.

THE OCCULTATION OF VENUS.

On the evening of December 8th an occultation of Venus by the moon occurred, and, as the night was beautiful and clear, the spectacle was witnessed by a large number of our citizens.

We reprint from the *Journal of Commerce*, of this city, the following description, and at the same time acknowledge our indebtedness for the use of the cuts illustrating the occultation:

The following diagrams illustrate the position of the planet, with reference to the moon, at the beginning and end of the occultation, as seen from Kansas City. The arrows represent the direction of the *astronomical* north and south; the angle which the arrows form with the column rules of the paper is equal to what is known to astronomers as the parallactic angle. It value is 34.3 degrees. The times given below are calculated as nearly as can be done by an "amateur" astronomer without the aid of the instruments necessary to a minute calculation.

No. 1.

No. 2.

[A vexatious blunder by the engraver, too late to be remedied, makes it necessary to explain that the white crescent represents the visible portion of the moon, and the black part the invisible portion.]

At about ten minutes past six, the moon being about 15 degrees above the horizon in the west, the position of Venus will be on the upper left of the moon's dark limb, which will then begin to creep over the planet. The apparent diameter of Venus is, then, 24 8 seconds of an arc; a distance which the moon will describe in very nearly one minute of time. But, as seen through the telescope, Venus is almost exactly half full, giving a miniature representation of the moon when the latter is a week old. The bright half of the planetary disc is that nearest the moon, and it will be covered in about thirty seconds after the beginning of the occultation, though the light of the planet may be partially visible to the naked eye for a very few seconds more. This will be the most interesting phase of the phenomenon. The dark limb of the moon *may be* faintly visible at the time: this will depend chiefly upon the quantity of cloud vapor in the atmosphere to the southwest of us. It will probably be invisible, and in that case, if the sky be clear

here, the brilliant planet will present the strange appearance of being utterly extinguished, in the short space of half a minute, without obvious cause, Venus being 0.4 degrees distant from the nearest point of the lunar cresent. If the dark part of the moon should be faintly perceptible we shall then have a chance to see the old "Dragon" of ancient stellar lore literally eating its way into the Hesperian star, and swallowing her up into utter darkness.

The planet will remain behind the moon for one hour and two minutes, as seen from Kansas City. At about fifteen minutes past seven o'clock the planet will peep out from behind the southern horn of the moon, near the position shown in our second diagram, and occupy 1.3 minutes in emerging, the motion outward being very oblique. Her position at emersion will be 156 degrees from the astronomically north point of the moon's limb; and 15½ degrees east from the point of the limb which is nearest to the horizon. At this time the moon's altitude will be only 8.7 degrees from the horizon.

The time and phase of the event vary materially with the point on the earth's surface on which the observer is situated. The reason for this is found in her relatively small distance from the earth, which causes an angular change in her position equal to her whole diameter, corresponding to a difference of about thirty-three degrees in latitude on the earth's surface. Two observers may be separated by thirty-three degrees of latitude, and one of them see a star apparently on the southern limb of the moon, at the same instant that the other observer sees the same star on her northern limb. It is this fact that makes the calculation of an occultation, or solar eclipse, a lengthy one, involving the solution of several spherical triangles, and making a knowledge of the calculus highly desirable, though not an absolute necessity. The apparent position of the moon, with reference to the star or planet, at any instant varies with the position of the observer on the earth's surface.

The occultation of Venus by the moon, when both are favorably situated for observation, is a very rare phenomenon. The last exhibition of the kind witnessed here occurred seventeen years ago, in April, 1860. The planet was then, as now, near her greatest eastern elongation from the sun, and the moon four days old; but both were much higher than they will be to-night, as they were near the northern solstice.

The distance of Venus from the earth at the time will be about 257 times that of the moon, the respective distances being 63,000,000 and 240,000. This fact enables us to account for the apparently small size of Venus, though her lineal diameter is to that of the moon as 362 to 106.

THE AGE OF THE SUN.

There has been a long dispute between the physicists and mathematicians on the one hand and the geologists and biologists on the other, as to the age of the earth, or rather, since that is equally involved, the age of the sun.

Dr. Croll, the distinguished Scotch geologist, has recently offered a theory which is not altogether new, but admits of some novel arguments, and which may serve all parties to the dispute. Beginning with a review of the different theories as to the sun's heat, he rejects the combustion theory as totally inadequate, since if the sun were all a burning coal, it would not last over 5,000 years; the chemical theory does not prolong the duration sufficiently; the meteoric theory will not serve; the only remaining theory is the gravitation or condensation theory. This supposes that the materials of the solar system were originally a nebula, extending through a space many times greater than the orbit of Neptune. The falling together, the condensation of this amount of matter, it can be mathematically shown, would supply enough heat to keep the sun at its present temperature for 20,600,000 years. Unfortunately, that period is not sufficient for the geologist. He demands at least 100,000,000 years for the changes of the earth's surface and would prefer twice that length of time. The arguments of the geologist are almost unanswerable; those of the biologist who believe in evolution tend to the same point so far as they go. Prof. Croll says that there is a way out of this difficulty, by supposing that the nebula was not cold but hot. If you suppose it hot enough to start with, you will have heat enough to carry you through. Obviously it is just as easy to suppose a hot nebula as a cold one. But Prof. Croll proposes to provide for this original heat. If the solar system had originally consisted of two masses, each of half the density of the whole, at some immeasurable distance apart, and they fell foul of each other owing to their mutual gravitation, they would strike with a speed of 274 miles per second. If their motion was stopped by the concussion, an amount of heat would be developed sufficient to convert the whole into a nebula that would take 50,000,000 years to cool. This is decidedly an improvement on the cold nebula. But this supposes that the component halves before they started on their way to a collision; had no motion. Let us suppose that they were moving beforehand at the rate of 202 miles per second, and that this speed was added to what they got by gravitating toward each other; then we get, when they struck, a nebula extending beyond Neptune, and with heat enough for a sun of 100,000,000 years' of duration. If you insist on 200,000,000, you must give the original masses a speed of 676 miles per second, beforehand. It will be objected that no such motion has been observed in space. Even the planets do not make such fast time; the earth, for instance, going only a thousand miles in a minute. The fixed stars, whose motion has been ascertained, travel very much slower. But Prof. Croll says the fixed stars are those that have gone through the collision process, and have lost their motion. The new hypothesis goes behind the ordinary nebular theory in point of time, giving an explanation for the formation of the nebulæ. But it presupposes that there may be vast, cold, invisible masses of matter rushing through space with such velocity that their mere touch would convert our globe into red hot gases and distribute it through infinite space. The conception is not incompatible with the sudden

flaming out of a new star and its conversion into a nebula, as seems to have been the case with the Schmidt star in Cygnus; but the facts in that remarkable case were probably not known to Prof. Croll at the time his essay was written.—*N. Y. Tribune.*

WHAT HAS BECOME OF THE NEW STAR?

A remarkable discovery has been made by the astronomers of Lord Lindsay's observatory at Dunecht—a discovery the true meaning of which is not as yet fully perceived. It may be remembered that some nine months ago a new star, as it was called, made its appearance in the constellation Cygnus. This object shone out where before no star had been known to astronomers—not merely, be it noticed, where there was no visible star, but where none was recorded even in lists like Argelander's "Durchmusterung," containing hundreds of thousands of telescopic stars. It was not, however, altogether impossible that some small star within moderate telescopic range had existed in the spot where the new star shone out, and that in some way this small star had escaped observation. This seemed the more likely, because the new star had appeared in a part of the heavens very rich indeed in telescopic stars; at any rate, astronomers had reason to believe that they would be readily able to determine the question with a high degree of probability by watching the star as it gradually faded out of view. For a "new star" which had shone out in the constellation of the Northern Crown in May, 1866, and had been identified with a tenth-magnitude star in Argelander's list, had gradually faded out of view, and, growing yet fainter, had sunk through one telescopic magnitude after another until it shone again as a tenth-magnitude star only. Since that star had resumed its former lustre, or rather its former faintness, it seemed not unreasonable to conclude that so also would the star of Cygnus. We shall presently see how far this expectation was from being fulfilled.—*Prof. Proctor, in Popular Science Monthly for December.*

BOOK REVIEWS.

CONTEMPORARY ART IN EUROPE, by S. G. W. Benjamin; with illustrations. New York: Harper & Brothers; 1877. pp. 165, octavo. For sale by Matt. Foster & Co. Price, $3.50.

This book, which presents in its mechanical execution a choice specimen of the highest style of the "art preservative," is made up from a number of articles entitled "Contemporary Art in Europe," which appeared in *Harper's Monthly* during the past year, where they attracted marked attention from their graceful style, and at the same time, from the intimate acquaintance

with the subject manifested by the writer; also from the numerous most excellent illustrative engravings.

It is certainly a very opportune time for the sale of such a work in the United States, since we are as a people rapidly becoming imbued with a love of art in its higher and truer forms. As the author says, "we are evidently entering upon a period of art development that shall crystallize the still unformed and unorganized art talent of the community into art schools such as have distinguished the Old World." In order to do this successfully and systematically it is necessary for us to study art in other countries and among other peoples for the purpose of obtaining a clear idea of the philosophy of its growth and progress. The object of the author is to furnish us with a correct and comprehensive account of European art in its present condition.

Dividing the subject into the three heads of Contemporary Art in England, France and Germany, he first takes up that of England, and enters enthusiastically upon the subject, describing with minuteness the various art schools, such as the Royal Academy, the South Kensington Museum, the Grosvenor Gallery, &c., dwelling with artistic warmth upon the enormous amount of capital, labor and public interest expended upon art by the English people and government. After devoting more than fifty pages to a description of English artists of all classes, and works of art in every department of art including architecture, ceramic art and household art and illustrating them with wonderfully fine portraits of painters and representations of their characteristic productions, he seems to yield the palm to such artists as Millais and Leighton, and to conclude that some of the best work done in England is of the Decoration class.

Speaking of French art, he takes the position that no people ever had the art instinct more generally diffused, and that while the character of modern French art is sadly depraved, still it is due to the demoralization of the race, and that the responsibility rests with the public which demands such art; that while it is desirable that good art should be pure art, yet it may be technically of a high order while its moral tendencies may be debasing. That the original artistic genius of the nation continues in full force without any decline in vitality cannot be doubted. This is due, first to the natural talent of the people, and second to the fact that the French government has always fostered the growth of art by wise and far-seeing legislation and liberal appropriations. To such causes is attributable the immense galleries of Paris and the wonderful concentration of artists and art production which has caused the business connected with them to engross the attention of a large number and to employ perhaps a larger capital than any other legitimate business in the city, except that of hotels and restaurants.

Prominent among the government institutions for the encouragement of art are the Academie des Beaux Arts, the Ecole des Beaux Arts, the annual Exhibition of the Salon, the Hotel Drouöt, besides which there are numerous public and private galleries, art clubs and art schools.

After giving the merits of each prominent artist of France an impartial discussion, he evidently inclines to award the premium in their respective classes to Corot for landscapes, Bonheur for animal painting, and Millet for *spirituel* portraits of humanity, while Brèton as an acknowledged leader of the sympathetic school excels all living French artists. French architecture and ceramic art receive at his hands a well merited commendation.

Of German arts and artists probably neither equals those of the 16th century, when Holbein, Aldegrever and Dürer were in the zenith of their success and fame. Germany has the advantage of a long continued prestige in this line, having for centuries maintained a reputation unequaled by any nation except Italy, and it would be most remarkable should France and England which have but recently, so to speak, acquired a reputation for art, come to the front as competitors with her for public favor. They, however, under the inspiration of government patronage and with the advantage of having their talent concentrated at London and Paris instead of being scattered over the whole kingdom as in Germany, have made rapid strides and in their respective schools are rivalling her. Still the grand art centers of Germany at Munich, Düsseldorf and Berlin are sending forth works by such artists as Lenbach, Gabriel Max, Defregger and Knaus, which can scarcely be excelled by any contemporary artists of Europe. The result of his study of German art is that it rivals French art in technical qualities and surpasses it in imagination and moral grandeur.

He concludes his consideration of European contemporary art with the suggestion that "while there is much to admire in its present condition, when the relation it bears to the future of American art is examined, the characteristic which more than all others merits the thoughtful and impartial consideration of our artists is the sturdiness with which each European school of art preserves its own national identity. The best modern art, the truest art of all ages and climes has been that which has been most faithful to the instincts of the period and race which gave it birth. If, therefore, we desire to see a worthy natural school of art spring up in our land, let us first of all be true to ourselves. By all means let the study of foreign contemporary and ancient art be pursued, but the notion that our native methods and native ideas and culture can never equal those of the Old World should be frowned upon as not only unpatriotic but unreasonable until proved by larger experience."

As before remarked, the book itself is a fine specimen of art, and the author has handled the subject in a most interesting, skillful and comprehensive manner.

THE TELEPHONE, By Prof. A. E. Dolbear, Tufts College, author of "The Art of Projecting," etc. Boston: Lee & Shepard; New York: Chas. T. Dillingham. pp. 128. Price, $1.00. For sale by H. H. Shepard, Kansas City.

This is a very appropriate work for our community just at this time,

when we are about to have a lecture on the subject by Prof. Kedzie, of the State Agricultural College of Kansas, and for all persons who are interested in one of the most recent and useful discoveries in electricity.

Professor Dolbear discusses all the phenomena of sound, magnetism and electricity which are involved in the action of the Telephone, and gives directions for the construction of a speaking instrument invented by himself, in which magneto-electric currents are utilized for the transmission of speech and other sounds.

He also discusses the Telephones of Reiss, Gray and Bell, and concludes with the remark that there is nothing in the principles involved in their construction that was not known in 1840, and that "mechanism is all that is needed to realize completely the prophetic picture of the 'Graphic' of the orator who shall at the same instant address an audience in every city in the world."

It is a book of facts, lucidly written and very well illustrated with excellent wood cuts, well worth the perusal of all who desire to find the whole subject in a small compass.

MONEY AND LEGAL TENDER IN THE UNITED STATES, By H. R. Linderman, Director of the Mint. New York: G. P. Putnam's Sons; 1877. pp. 174, 12 mo. For sale by Matt Foster & Co. $1.25.

The object of this work is to set forth, in brief and convenient form, the laws relative to coinage, legal tender and the money standard of the country. Just at this time when the prominent national subject under consideration by Congress and by the people at large is that of bringing currency up to a specie basis, such a work will be found especially valuable, for whether all agree with Dr. Linderman's theories or not, all will accept his statements as unquestionable, and nine-tenths of those who read the work will be very glad to have these facts brought together for them in so convenient and compact a shape. The first chapter is devoted to a brief and uncommonly clear and definite explanation of the various terms used in treating of bullion, mint coinage and money, after which follow chapters upon the Provisions of the Constitution relative to the coinage of money and the regulation of its value; Legislation regulating the value of foreign coin; Metallic money in colonial times; Establishment of the mint, money standard, national coinage, money of account and legal tender; Coinage act of 1873, change from the dollar standard of gold and silver to the gold standard; What constitutes legal tender?; Paper currency since 1863; National currency secured by pledge of U. S. stocks; Mint weights and weighing of bullion and coin; Proposition for the remonetization of silver considered; Review of money situation in Europe; Appendix, with general summary and tabular statement of total coinage of the United States, etc. It is a work of decided interest and value to all classes, and doubtless will meet with great success.

XUM

THE AMOURS OF PHILLIPPE: A HISTORY OF PHILLIPPE'S LOVE AFFAIRS, By Octave Feuillet, translated from the French, complete and unabridged, by Mrs Mary Neal Sherwood, is published this day by T. B. Peterson & Brothers, Philadelphia. 50 cents.

It can be said of Octave Feuillet, as of very few contemporary French novelists, that he writes for the world and not simply for Paris. He writes of French life, but of life which Americans can understand, and not in that ghastly melodrama which is so foreign to all our natural sympathies, but which is brought before us again and again in the work of all the Parisian novelists of the day. This, his last romance, has just been completed in *Le Revue des Deux Mondes*, in Paris, passed through three editions in three days, and has been charmingly translated for Peterson's American edition, and is as strong and as earnest as any of the stories that have made Octave Feuillet's world-wide fame, being a series of keenly-drawn pictures of French social life by a dramatist and novelist who finishes as well as sketches his pictures, and who lives—not only exists—in the world that he paints.

OUR CHILDREN'S SONGS; illustrated. Harper & Bros., New York; 1878. pp. 208, octavo. For sale by Matt Foster & Co. $1.50.

This is truly a Christmas book for children of all ages and sizes, being a collection of all the juvenile poetry we have ever seen, and more too, from Jack and Gill in Songs for the nursery, through Songs for childhood, Songs for girlhood, Songs for boyhood to sacred songs for the nursery and hymns for childhood, closing with Bishop Heber's "Brightest and Best of the Sons of the Morning," and Joseph Addison's "Spacious Firmament on High;" the whole handsomely illustrated with nearly 100 engravings. It is just such a book as all children will be delighted with.

THE SIGNAL BOYS, OR CAPTAIN SAM'S COMPANY, By Geo. Cary Eggleston. New York: G. P. Putnam's Sons; 1878. 12 mo.; pp. 218. For sale by Matt Foster & Co. $1.50.

Another genuinely good story for boys; one which will not only interest them, but arouse their inventive faculties and stimulate them to deeds of manliness. Just such a book as every parent can unhesitatingly place in the hands of his son, with the certainty of his being benefited by it.

DOUBLEDAY'S CHILDREN, By Dalton Cook. G. P. Putnam's Sons, New York; 1877. 430 pp.; 12 mo. For sale by Matt Foster & Co. $1.50.

A story for children of a larger growth. The scenes are laid in England, France and Australia, and the author dextrously interweaves prominent historical events with the lives of his characters, making an entertaining and fascinating whole.

Signal Office Report from November 15 to December 15, 1877, by W. A. M. Vaughan, Observer, at Kansas City, Mo.

Date.	Missouri River above low water mark.	Direction of Wind.	State of Weather.	Remarks.
Nov. 15	5 feet 3 in.	S. W.	Clear.	
" 16	5 " 2 "	"	"	
" 17	5 " 8 "	"	"	
" 18	5 " 7 "	"	Fair.	
" 19	5 " 8 "	N. E.	Cloudy.	Light rain.
" 20	5 " 10 "	"	"	" .35 in.
" 21	5 " 8 "	"	Fair.	
" 22	5 " 9 "	"	Cloudy.	
" 23	5 " 8 "	S.	Clear.	
" 24	5 " 8 "	N. W.	Cloudy.	Light rain.
" 25	5 " 7 "	N. E.	"	
" 26	5 " 7 "	N. W.	"	
" 27	5 " 6 "	"	"	
" 28	5 " 10 "	"	Clear.	Ice running in river.
" 29	5 " 10 "	"	"	
" 30	5 " 6 "	N.	"	Ice running in river.
Dec. 1	5 " 5 "	S. W.	"	
" 2	5 " 5 "	"	Cloudy.	
" 3	5 " 4 "	N. W.	Fair.	
" 4	5 " 2 "	S. W.	Cloudy.	Light rain. .57 in.
" 5	5 " 0 "	N. W.	Fair.	
" 6	4 " 7 "	"	Clear.	
" 7	4 " 4 "	"	"	
" 8	4 " 0 "	N. E.	"	
" 9	4 " 0 "	S. W.	Fair.	
" 10	3 " 11 "	"	"	
" 11	3 " 11 "	"	Clear.	
" 12	4 " 0 "	"	"	
" 13	4 " 2 "	"	"	
" 14	4 " 1 "	"	Cloudy.	
" 15	4 " 0 "	"	Fair.	

Meteorological Record, by J. P. Kenmuir, Kansas City, Mo.

	BAROMETER.			FAHR. THERMOMETER.		
December	6 A. M.	1 P. M.	6 P. M.	6 A. M.	1 P. M.	6 P. M.
1	30.05	30.08	30.12	12°	30°	28°
2	30.05	29.93	29.90	26°	46°	40°
3	29.88	29.78	29.60	38°	36°	36°
4	29.41	29.50	29.66	38°	39°	36°
5	29.78	29.80	29.92	30°	32°	32°
6	30.10	30.16	30.06	24°	32°	34°
7	30.06	30.12	30.12	29°	43°	36°
8	30.25	30.25	30.22	28°	41°	35°
9	30.05	29.94	29.94	36°	52°	48°
10	30.00	30.00	30.00	36°	52°	50°
11	30.00	29.98	29.97	44°	58°	56°
12	29.97	29.95	29.98	47°	63°	56°
13	30.18	30.24	30.24	36°	52°	44°
14	30.18	30.24	29.97	34°	53°	48°
15	29.88	29.88	29.90	55°	61°	57°

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EDITORIAL NOTES.

KANSAS CITY ACADEMY OF SCIENCE.

The Academy met at its rooms on the evening of the last Tuesday in November. The attendance was unusually large, the room being filled completely. Judge West occupied the chair, and Prof. Sheffield acted as Secretary.

A letter from Prof. W. K. Kedzie, of the Kansas Agricultural College, proposing to deliver a lecture during the Holidays, on the Telephone, with experiments, was read, and on motion a committee was appointed to arrange the time and place

On motion Mr. Francis Devens, of this city, was elected a member of the Academy, and appointed Taxidermist.

After some other business, a paper on "Some of the Objections to the Evolution Theory," was read by T. S. Case, which elicited an animated discussion. This was followed by a paper on "Short-Sightedness in School Children," by Prof. J. M. Greenwood, Principal of the Kansas City Public Schools. Both of these papers will be found in this number of the REVIEW.

At the request of the Academy, Col. R. T. Van Horn consented to furnish a paper for the next meeting, upon "The Atmosphere." It was also announced that Miss Murdfeldt, of St. Louis, would read an essay upon "Entomology," and that Prof. Broadhead, of Pleasant Hill, Mo, would read one upon the "Missouri Iron Ores of the Carboniferous Age." This will be a most interesting meeting and should draw a large audience.

THE lecture of Prof. Kedzie upon the Telephone will be illustrated by the use of twelve instruments, together with large charts explaining and illustrating the action of the instruments, and more than a mile of wire. The Professor writes to a friend in the city that he has been experimenting considerably and has made some very interesting discoveries. His lecture will take place December ..... of which due notice will be made in the daily papers.

THE subjoined letter, from an old citizen, will be of interest to those of our readers who pay attention to archæology:

KANSAS CITY, Nov. 29, 1877.

COL. CASE:—Hearing of the interest you take in the mounds of Missouri, and having traveled over all the State and examined a large number of them, I take this opportunity to give you a little information respecting the location of a few. The only one I ever examined closely was in Newton county, on Five Mile Creek, some eight miles southeast of Baxter. I opened a small mound there and found Indian bones, but they fell to a gray powder as soon as they were exposed to the air. I found a flint ax, fifty arrow heads, stone pipe, and ten copper rings, suppose they were on the Indian's arm. The largest mound I know of is in Cooper county, on the Lamine river, near Buffalo Prairie. It is halt a mile south of the salt springs, on what is called the Bailey farm. To find it, take the M., K. & T. R. R. at Sedalia and go to Harris' Station, 21 miles from Sedalia. Inquire there for Conrad Cash and he will guide you to them. This mound is about twenty feet in diameter and about six feet high. There are several large trees near it, one on the top. It has large stones around it set up on edge. I had a man dig down three feet on top and he came to a large flat stone which seems to cover the whole mound. It sounded hollow and I think there is a kind of vault under it. The country surrounding this place was at one time a great hunting country, as the game came here from far and wide on account of the number of salt springs. The mound is on a high hill overlooking Saline county. C. C. C.

THE value of the storm warnings of the Signal Service becomes daily more apparent. The heavy gale in the midst of which the unfortunate Huron went ashore on the North Carolina coast was extremely severe in many parts of Virginia, Maryland and Georgia, as well as in

other sections of the country. The floods caused by the sudden rising of the Potomac, the James, the Shenandoah and the Dan rivers, and many smaller streams in their vicinity, caused great destruction of property. In Richmond, Virginia, the lower part of the city was inundated, the flood spreading over whole blocks, submerging the gas works, leaving the city in darkness, and causing immense damage. Persons who remained in dwellings in the flooded locality were driven from floor to floor, and in many instances were finally removed in boats to places of safety. But the Signal Service had previously issued its warning note and foretold a sudden rise in the Virginia rivers, so that at Richmond and at other places much movable property had been placed beyond the reach of high water before the floods came. The same warnings were specially serviceable to shipping in harbor, and in the case of the Huron the result may be attributed directly to an over-confidence of Commander Ryan in his own ability and in the sea-worthiness of his vessel.

A NEW composite metal, called *Goloid*, has been lately patented and seems to present several valuable properties, which were recently explained by the inventor to the House Committee on Coinage, Weights and Measures. The composition represents 40 per cent as compared with gold and 60 per cent as compared with silver. When combined with alloy, the mixture representing the value of the silver dollar would be but half the bulk. He said it had one peculiarity. Its density is greater than the average density of its components. It is at a premium of three per cent in England today, for the reason that its chemical affinity for gold makes it a valuable agent in mining, and separates particles of gold which would otherwise be lost. One advantage which it possesses is its hardness, in which it exceeds gold.

A VERY LARGE AND BEAUTIFUL METEOR passed nearly over this city on Sunday, the 2d inst., at about 6 P. M. It was not so large, apparently, as that of last spring, but passed nearly in the same direction and at about the same rate of speed.

A smaller one was seen to fall from the northern sky, at about the same hour of the evening, on Nov. 29th. It was apparently very close to this city and seemed to fall in Clay county, just north of Harlem.

SIR JOSEPH HOOKER, who in company with Prof. Asa Gray and Prof. O. C. Marsh, passed through Kansas City last summer on his way to join Dr. Hayden's geographical survey, has returned to England and communicated the result of his observations to *Nature*, (Oct. 25.) Among other interesting things said with reference to the flora of the Rocky Mountains, he says: "Lastly, curious information was obtained respecting the ages of not only the big trees of California but of equally aged pines and junipers, which are proofs of that duration of existing conditions of climate for which evidence has hitherto been sought amongst fossil rather than living organisms."

PROF. HITCHCOCK is now engaged in securing some of the celebrated fossil bird tracks along the shore of Wethersfield Cove, near Hartford, Conn. To obviate the brittleness of the rock formation, he digs down deeply under any specimen he desires to obtain, and places in position a sort of platform of two-inch plank bolted together, fills underneath and around the rock with cement, which soon hardens and holds all together. In this way he is enabled to remove the entire mass in one body.

CAPT. TYSON has reported to Capt. Howgate the safe arrival of the arctic vessel Florence at Niantitick Harbor, Cumberland Gulf, on Sept. 29. Capt. Tyson proposed removing to and establishing his headquarters at the head of the Gulf in a few days and entering upon the work of collecting materials for the principal expedition next summer. Messrs. Sherman and Kumlein are doing well in their respective departments, though the latter hoped for better success in collecting specimens of natural history after the change of quarters.

THE Denver & Rio Grande R. R. (narrow Gauge) has been completed to Garland City,

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27 miles from La Veta. The work will be pushed forward as rapidly as possible until the road reaches the San Juan mining district. Some of the finest engineering ever done in this country has been done on this road by Col. McMurtry, and it is claimed that it attains the highest elevation of any railroad in the United States—nearly 9,339 feet above the level of the sea—in crossing the Sangre de Christo pass.

We are pleased to announce that we can furnish the REVIEW for the succeeding year, with Popular Science Monthly, Popular Science Monthly Supplement, Van Nostrand's Engineering Magazine, Scientific American, New York Medical Journal, American Naturalist, American Journal of Science and Arts, North American Review, Atlantic Monthly, Harper's Monthly, Appleton's Journal, at rates much below the regular price of it and any one of them alone. Terms made known on application.

THE POSTAL GUIDE is a quarterly publication of over 200 pages, which contains information relative to the postal service, rates of foreign and domestic postage, rulings of the Department, list of post offices, money order offices, &c., &c., which every business man needs. We can furnish it at $1.50 per annum, or 50c. per single copy.

PROF. AUGHEY, of the Lincoln University of Nebraska, has written a very full and interesting account of the so-called Nebraska volcanoes, in which he explains that they are simply portions of the river bluffs which have been undermined and fallen into the water, where the sulphurets and other minerals have become slaked, thereby creating the heat which produces the steam, smoke and flames, causing the resemblance to real volcanoes.

PROF. TIFFIN SINKS, M. D., is delivering a series of lectures upon Evolution before the Leavenworth Academy of Science. The first of the course was given at the regular meeting in November, and, according to the *Times* of that city, was very able, creating a high degree of interest among his auditors. The second lecture will be delivered this evening, Dec. 18.

PROF. ROBERT GALLAWAY suggests the use of phosphate of potash is a much better remedy for scurvy than lime juice, and at the same time increases the nutritiveness of salted meat.

PERIODICALS RECEIVED.

New York Medical Journal, D. Appleton & Co., N. Y. $4.00
American Naturalist, H. O Houghton & Co., Boston, ... 4.00
American Journal of Science and Arts, New Haven, ... 6.00
Popular Science Monthly, D. Appleton & Co., N Y., ... 5.00
Van Nostrand's Engineering Magazine, D. Van Nostrand, N. Y., ... 5 00
Gardener's Monthly, C. H. Marot, Phila., $2.10
North American Review, J. R. Osgood & Co., Boston, ... 5.00
Engineering and Mining Journal, N. Y., .. 4.00
Science Observer, Boston, ... 50
Boston Journal of Chemistry, Boston, ... 1.00
Sanitarain, N. Y., ... 3.00
Druggist's Circular, N. Y., ... 1.50
New Remedies, W. W. Wood & Co., N. Y. 1.50
London Journal of the Telegraph, London, 4s.
London Journal of Applied Science, " 4s.
Library Table, H. L. Hinton & Co, N. Y., 2 00
Monthly Weather Review, Washington, D C.
Popular Science Monthly, Supplement, N. Y., ... 3.00
Engineering and Mining Journal, N. Y, weekly, ... 4.00
Mines, Metals and Arts, C. E. Ware & Co, St. Louis, ... 2.00
Scientific American, N. Y, ... 3.20
Phrenological Journal, S. R. Wells & Co., N. Y, ... 2.00
Kansas Farmer, J. K. Hudson, ... 2.00
Western Agriculturist, Quincy, Ills., ... 2.00
Kansas Collegiate, Topeka, Kans., ... .50
The Jewell, Liberty, Mo, ... 1.00
Report of Kansas State Board of Agriculture.
The Institute, Nov., 1877, Glasgow, Mo.
The College Chaplet, St Joseph, Mo., ... 1.00
Medical Record, weekly, W. W. Wood & N. Y., ... 5.00
Ohio Educational Monthly, Salem, O., ... 1.50
Ohio Medical and Surgical Journal, Columbus, Ohio 2.00